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Short term benefits for laparoscopic colorectal resection (Review)

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TABLE OF CONTENTS

[Intervention Review]

Short term benefits for laparoscopic colorectal resection

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ABSTRACT

Background

Colorectal resections are common surgical procedures all over the world. Laparoscopic colorectal surgery is technically feasible in a considerable amount of patients under elective conditions. Several short-term benefits of the laparoscopic approach to colorectal resection (less pain, less morbidity, improved reconvalescence and better quality of life) have been proposed.

Objectives

This review compares laparoscopic and conventional colorectal resection with regards to possible benefits of the laparoscopic method in the short-term postoperative period (up to 3 months post surgery).

Search methods

We searched MEDLINE, EMBASE, CancerLit, and the Cochrane Central Register of Controlled Trials for the years 1991 to 2004.
We also handsearched the following journals from 1991 to 2004: British Journal of Surgery, Archives of Surgery, Annals of Surgery, Surgery, World Journal of Surgery, Disease of Colon and Rectum, Surgical Endoscopy, International Journal of Colorectal Disease, Langenbeck's Archives of Surgery, Der Chirurg, Zentralblatt für Chirurgie, Aktuelle Chirurgie/Viszeralchirurgie. Handsearch of abstracts from the following society meetings from 1991 to 2004: American College of Surgeons, American Society of Colorectal Surgeons, Royal Society of Surgeons, British Assocation of Coloproctology, Surgical Association of Endoscopic Surgeons, European Association of Endoscopic Surgeons, Asian Society of Endoscopic Surgeons.

Selection criteria

All randomised-controlled trial were included regardless of the language of publication. No- or pseudorandomised trials as well as studies that followed patient's preferences towards one of the two interventions were excluded, but listed separately. RCT presented as only an abstract were excluded.

Data collection and analysis

Results were extracted from papers by three observers independently on a predefined data sheet. Disagreements were solved by discussion. 'REVMAN 4.2' was used for statistical analysis. Mean differences (95% confidence intervals) were used for analysing continuous variables. If studies reported medians and ranges instead of means and standard deviations, we assumed the difference of medians to be equal to the difference of means. If no measure of dispersion was given, we tried to obtain these data from the authors or estimated SD as the mean or median. Data were pooled and rate differences as well as weighted mean differences with their 95% confidence intervals were calculated using random effects models.

Main results

25 RCT were included and analysed. Methodological quality of most of these trials was only moderate and perioperative treatment was very traditional in most studies. Operative time was longer in laparscopic surgery, but intraoperative blood was less than in conventional surgery. Intensity of postoperative pain and duration of postoperative ileus was shorter after laparoscopic colorectal resection and pulmonary function was improved after a laparoscopic approach. Total morbidity and local (surgical) morbidity was decreased in the laparoscopic groups. General morbidity and mortality was not different between both groups. Until the 30th postoperative day, quality of life was better in laparoscopic patients. Postoperative hospital stay was less in laparoscopic patients.

Authors' conclusions

Under traditional perioperative treatment, lapararoscopic colonic resections show clinically relevant advantages in selected patients. If the long-term oncological results of laparoscopic and conventional resection of colonic carcinoma show equivalent results, the laparoscopic approach should be preferred in patients suitable for this approach to colectomy.

PLAIN LANGUAGE SUMMARY

Short-term benefits for laparoscopic colorectal resection

Colorectal cancer is one of the most common cancers in industrialised countries, in both female and male persons. Treatment involves surgical removal (resection) of the segment of the bowel containing the tumor and wide tumorfree margins. Lymph nodes in the area are also removed (lymphadendectomy). conventional surgery which is the mainstream treatment of colorectal cancer and has good survival rates for stage-1 tumors. Other diseases that can require removal of sections of the large bowel include inflammatory diseases such as diverticulitis, Crohn's disease, ulcerative colitis, familial adenomatous polyposis (FAP) and rectal prolapse.

The conventional approach to surgery involves making a cut through the abdominal wall. For many people it is now possible to use video-endoscopic surgery (laparoscopy), which may have short term advantages that include less pain, better pulmonary function, shorter time for return of bowel function (duration of postoperative ileus), less fatigue, better quality of life and improved convalescence. However, the procedure is complex and for colorectal cancer the oncological long-term results on survival not known.

The review authors identified 25 controlled trials in which 3526 men and women were randomized to one surgical technique or the other. Colorectal resection was most often required for colorectal carcinoma. Overall, laparoscopic colon resections showed advantages over conventional surgery. Blood loss was a little less (by 113 to 31 ml, mean 72 ml); pain, which was treated with epidural or patient-controlled on demand analgesia, was less intense; time to return of bowel function was less, by about one day; lung function was improved with reduced postoperative stay in hospital (by 1.4 days) and improved quality of life in the first 30 days. The operation time was longer with laparoscopic surgery than with conventional surgery (by 42 minutes, range 30 to 55 minutes). Re-operation was not more likely after laparoscopic surgery and general complications in the lungs, heart, urinary tract or deep vein thrombosis (DVT) were similar with the two surgery techniques. Wound infections were less in laparoscopic patients. Some patients are not suitable for laparoscopy.

BACKGROUND

Colorectal cancer is one of the most common cancers in both female and male persons in the industrialized nations of Europe, America, Asia and Australia. Radical resection of the tumor bearing segment of the bowel with wide tumorfree resection margins and a systematic lymphadendectomy is the mainstem of curative therapy of colorectal cancer. Five year survival rates after R0-resection of colorectal cancer vary with the UICC-tumor stage from almost 100% (stage I) to 50% (stage III) (Ries 2000). Other diseases that may require elective resection of the large bowel are diverticulitis, Crohn's disease, ulcerative colitis, and familial adenomatous polyposis (FAP).

Until today conventional surgery via laparotomy remains the "gold standard" for elective colorectal resection in both benign and malign disease. The evolution of video-endoscopic surgery led to the idea of laparoscopic colorectal resection, which was first described in 1991(Franklin 1993; Jacobs 1991). Short term advantages of the laparoscopic compared to the conventional approach to colorectal resection have been suggested early (Lacy 1995; Ortiz 1996): less pain, better pulmonary function, shorter duration of postoperative ileus, less fatigue, better quality of life. However, the new method has not gained the same acceptance as laparoscopic cholecystectomy because short term advantages seemed not to be as obvious as for laparoscopic cholecystectomy, the procedure ist much more complex and the oncological long-term results of laparoscopic colorectal cancer resection are not known.

While randomised controlled trials to evaluate recurrence rates and survival of patients undergoing laparoscopic or conventional resection of colorectal carcinoma will require large number of patients (n > 900), clinically relevant short-term benefits of the minimal-access could already be identified in much smaller trials (n > 150). On the other hand, if short-term benefits of laparoscopic colorectal resections are not identified in smaller trials, there is no reason to perform larger multicenter trials to evaluate the long-term results.

The aim of this systematic review of randomised controlled trials was to evaluate whether there are clinically relevant short-term advantages of laparoscopic compared to conventional colorectal resection.

OBJECTIVES

This review compares laparoscopic and conventional colorectal resection with regard to possible benefits of the laparoscopic method in the short-term postoperative period (surgery to 3 months postoperative).

METHODS

Criteria for considering studies for this review

Types of studies

All randomised controlled trials comparing laparoscopic and conventional colorectal resection for benigne or maligne colorectal disease. Trials that allocated patients depending on the availablility of staff or instruments or the number of the day (odd or even) were excluded from the analysis. If the method of randomisation was not specified, if a trial was only reported as an abstract or if no measure is given for an outcome variable, the authors were contacted to give full details of their study. If no further infomation was received from the authors, studies reported only as abstracts were excluded from further analysis.The decision to exclude a trial was discussed between three observers and disagreements were resolved by discussion. Trials were included irrespectively of the language of publication.

Types of participants

All patients with either benigne or maligne colorectal disease requiring curative or palliative colorectal resection.

Types of interventions

Laparoscopic or laparoscopic-assisted colorectal resection with intraperitoneal gas insufflation or mechanical abdominal wall lift. Interventions are included when the minimal invasive technique includes dissection of the mesentery and mobilisation of the diseased bowel segment. Anastomosis can either be performed intraperitoneally (i. e. 'double-stapled' colorectal anastomosis) or extraperitoneally (i. e. handsewn or stapled ileotransversostomy). The type of anesthetic and/or analgetic technique (peridural catheter, pca) as well as details of the perioperative therapy (use of drains and tubes) were recorded.

Types of outcome measures

The following outcome measures will be sought for in all randomised contolled trials:
- patient characteristics (sex, age),
- intraoperative data (duration of surgery, length of incision, blood loss)
- morbidity (surgical: wound healing impairment, anastomotic insufficiency, bleeding, abscess, complications requiring reoperation; general: pulmonary complications, cardiac complications, urinary tract infections, thrombosis of the deep venous sytem of the lower extremities, pulmonary embolism) and mortality,
- postoperative pain perception (in mm on a VAS-scale),
- postoperative pulmonary function (forced vital capacity),
- duration of postoperative ileus (time from surgery to first passing of flatus and stool),
- hospital stay,
- quality of life.

Search methods for identification of studies

See: Collaborative Review Group search strategy.

We conducted database searches for randomised controlled trials for the years 1991 to 2004 using MEDLINE, EMBASE, CancerLit and the Cochrane Central Register of Controlled Trials. The Cochrane Collaboration highly senstive search strategy for randomised controlled trials was combined with the following MeSH terms:

colon*.ME
colectomy*.ME
proctectomy*.ME
intestine-large*.ME
colonic neoplasm*.ME
rectal neoplasm*.ME
laparosc*.ME.

The following journals were handsearched from 1991 to 2004 for randomised controlled trials or clinical controlled trials: British Journal of Surgery, Archives of Surgery, Annals of Surgery,

Surgery, World Journal of Surgery, Disease of Colon and Rectum, Surgical Endoscopy, International Journal of Colorectal Disease, Langenbeck's Archives of Surgery, Der Chirurg, Zentralblatt für Chirurgie, Aktuelle Chirurgie/Viszeralchirurgie.
Further, abstracts from the following society meetings were handsearched from 1991 to 2004. American College of Surgeons, American Society of Colorectal Surgeons, Royal Society of Surgeons, British Assocation of Coloproctology, Surgical Association of Endoscopic Surgeons, European Association of Endoscopic Surgeons, Asian Society of Endoscopic Surgeons.
The reference lists of all relevant articles were searched for further relevant trials. All authors of identified randomised controlled trials were contacted to evaluate whether they have any information on any other recent or ongoing trials. Local opinion leaders in Europe, America and Asia were contacted with the same question.

Data collection and analysis

All studies that met the selection criteria were assessed for methodological quality and the details of the randomisation process. This judgement was performed by three reviewers. Where a difference in opinion existed,it was resolved by discussion. All non-randomised studies were excluded. Pseudo-randomised studies as well as studies that followed patient's preferences towards one of the two interventions were excluded, but listed separately. Each included trial was read independently by three investigators for the criteria: concealed randomisation, time of randomisation (preoperativly, intraoperatively), number of randomised patients, number of patients not randomised and reasons for this, exclusion after randomisation, and dealing with drop outs, blinding of the patient and observer, data analysis according to the 'intention-to-treat'-principle. Methodological quality of each manuscript was scored by three reviewers using a modified Evans and Pollock Questionaire (Evans 1985). In this questionaire the quality of the design, the analysis and the presentation of the trial were scored. The scores ranged from 0 to 50 for the design, 0 to 30 for analysis and 0 - 20 for presentation of the data. Therefore the maximum score was 100. We considered the methodological quality of the manuscripts as low (E/P-score < 40), moderate (E/P-score 40 - 70) or high (E/P-score > 70).

Three observers independently extracted the results of each paper on a predefined data sheet; disagreements were solved by discussion. The software 'REVMAN 4.2' provided by the Cochrane Collaboration was used for statistical analysis. Mean differences with their corresponding 95% confidence intervals were used for analysing continuous variables. If studies reported medians and ranges instead of means and standard deviations, we assumed the difference of medians to be equal to the difference of means. If no measure of dispersion was given, we tried to obtain these data from the authors or estimated SD as the mean or median. For dichotomous variables rate differences with their 95% confidence intervals were calculated. We pooled effect measures within random effects models (DerSimonian 1986). To evaluate the between-study variability we statistically tested for heterogeneity of results (Hardy 1998). For dichotomous outcomes we calculated the number of patients that need to be treated to prevent one complication (NNT).

RESULTS

Description of studies

40 publications from randomised controlled trials (RCT) were identified during our literature search. Contact to opinion leaders in Europe, America and Asia did not yield any addtional data on further RCTs. 15 publications had to be excluded from further analysis: 10 publications because the data in this manuscripts was included in another publication (Böhm 1999; Delgado 2001; Lacy 1995; Lacy 1998; Ordemann 2001; Schwenk 1998 a; Schwenk 1998 b; Schwenk 1998 c; Schwenk 1999); one trial did not contain any clinical data we sought for (Kim 1998); in one trial randomisation was not followed if there was a strong patient preference for either the laparoscopic or the conventional technique (Hotokezaka 1996); one trial investigated two different anastomotic techniques during laparoscopic sigmoidectomy (Bergamaschi 2000); one trial compared hand-assisted laparoscopy (HALS) to laparoscopy (Targarona 2002) and one trial investigated differences between gasless laparoscopy and pneumperitoneum during laparoscopic colectomy (Schulze 1999).

The characteristics of the 25 included trials are summarised in the 'Characteristics of includes studies' table. All 25 trials were reported as full papers and included a total of 3526 participants. Most studies included patients with colorectal carcinoma. Quality of Life data of a subgroup of patients from the COST-trial (COST 2004) had been published by Weeks et al. (Weeks 2002) before the results of the whole patient publication were reported. Therefore Weeks 2002 was only considered for their Quality of Life data and not included in any other analysis. One other publication divided the patients in two groups: colorectal carcinoma and crohn's disease. Therefore we decided to extract the data from this publication for each of both groups seperately and cite them as different studies (Hildebrandt 2003 a; Hildebrandt 2003 b).
Patients with diverticular disease were only included in two reports from the same authors (Braga 2002 a; Braga 2002 b). Rectal prolapse was the indication for surgery in one trial (Solomon 2002) and patients with chronic inflammatory bowel disease were treated by (Dunker 2002; Milsom 2001; Hildebrandt 2003 b). All included studies with patients treated for colorectal carcinoma had quite similar criteria to exclude patients from the study.
The most common exclusion criteria were: cancer of the lower rectum scheduled for low anterior resection with total mesorectal excision, carcinoma of the transverse colon, obstructing tumors, tumors infiltration adjacent organs.

Perioperative treatment of patients was not described exactly in most of the reviewed trial. Exact data on the type of anesthesia and analgesia (i. e. epidural catheter, schedules for postoperative pain therapy) were not given in many trials. While most of the RCT described the technique of laparoscopic surgery, only 8 of the 25 trials (Danelli 2002; Hildebrandt 2003 a; Hildebrandt 2003 b; Milsom 1998; Milsom 2001; Schwenk 2002; Stage 1997; Winslow 2002) stated the type of incision in conventional surgery. In all these 8 trials a median or paramedian incision were performed. No study reported using transverse incisions. In 12 publications no statements concerning anesthesiological techniques or postoperative analgesia were found. Of those 13 trials that contained information on postoperative analgesia, 7 used systemic on-demand (Leung 2000; Leung 2004) or patient-controlled analgesia (Hewitt 1998; Milsom 1998; Milsom 2001; Schwenk 2002; Solomon 2002), 2 trials performed either epidural

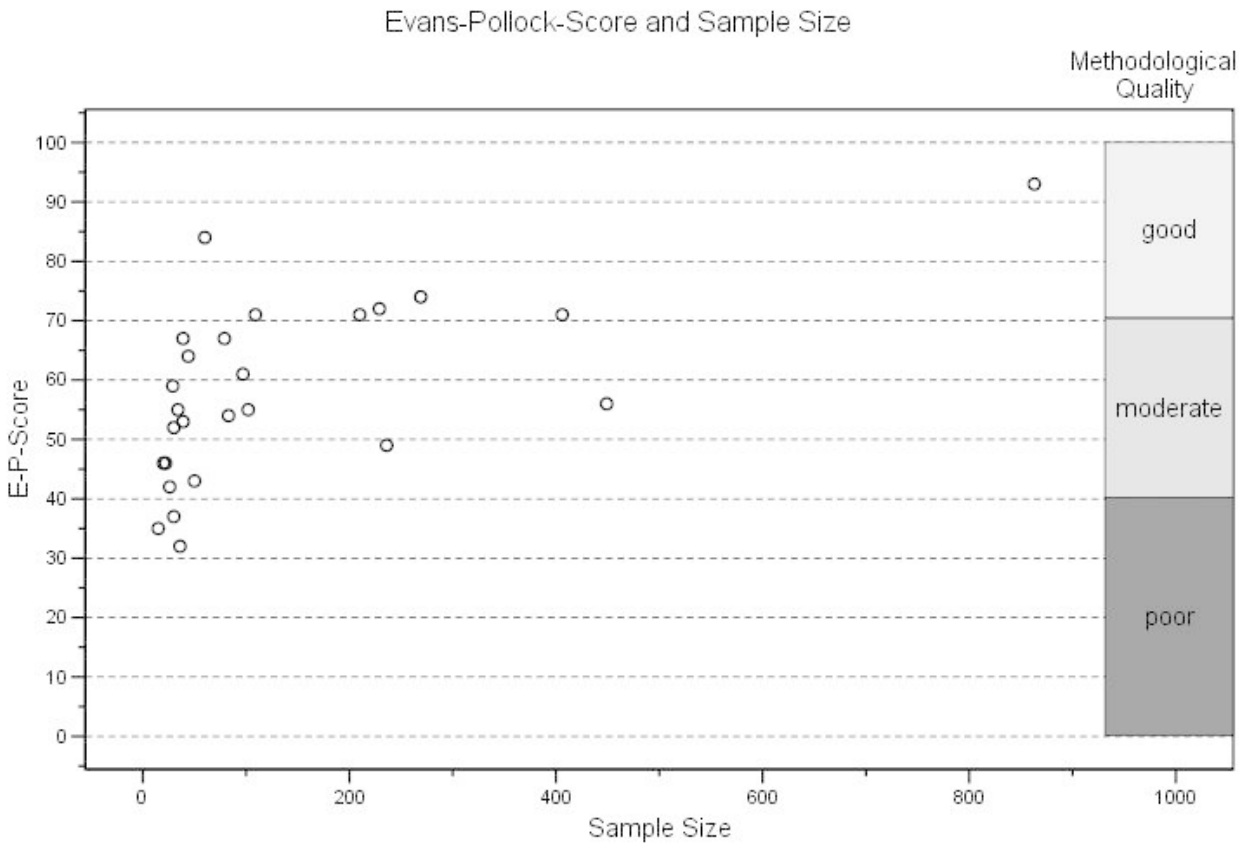
or systemic on-demand analgesia (Hasegawa 2003; Janson 2004), 3 epidural or systemic patient controlled analgesia (Braga 2002 a; Braga 2002 b; Danelli 2002) and in 1 trial epidural analgesia was always utilized (Stage 1997).

Most of the studies assessed several outcome parameters to describe the postoperative course of the patients. The most commonly assessed parameters were operative time, return of bowel function, morbidity, mortality, and hospital stay. Only few studies evaluated outcome measures like pain (Braga 2002 a; Danelli 2002; Hewitt 1998; Leung 2000; Leung 2004; Schwenk 2002; Stage 1997) or quality of life (Schwenk 2002; Weeks 2002) in detail. Data on immunological and inflammatory reactions were not analysed in this review (Hewitt 1998; Stage 1997; Tang 2001).

Risk of bias in included studies

The sample size of most trials was small. Only 7 trials included more than 100 patients (Braga 2002 b; COST 2004; Janson 2004; Lacy 2002; Leung 2004; Milsom 2001; Schwenk 2002; Tang 2001; Weeks 2002) and only one report contained more than 500 patients (COST 2004) (Figure 1). The methodological quality of most included studies as extracted from the manuscripts was moderate. The mean Evans and Pollock-Score for all trials was 58 (95% CI 52-64). Only 7 trials were considered to be of good methodological quality (Evans and Pollock Score > 70) (Braga 2002 b; COST 2004; Janson 2004; Lacy 2002; Leung 2004; Milsom 1998; Milsom 2001), 3 were considered being of poor quality and 15 trials were of moderate quality (Figure 1). Most of the studies had the same methodological problems, namely: unclear technique of randomisation, unclear adequacy of allocation concealment, inadequate statistical tests or failure to perform an intention-to-treat-analysis. Patients who were intraoperatively converted to open resection were excluded from further analysis in 6 studies (Hewitt 1998; Milsom 2001; Ortiz 1996; Stage 1997; Tang 2001), and analysed seperately in two RCT (Curet 2000; Winslow 2002). Extracting data for several endpoints was very difficult, because values had to be estimated from figures.

Figure 1.



Effects of interventions

1) Patient data

In 22 trials with 2965 participants, there were 1420 female patients (47,9%). There were no differences in sex between patients treated laparoscopically or conventionally (Risk Reduction (RR): 1.05 [95% CI 0.98 to 1.13; p = 0,19]. (Comparison: 01.01)

Patients treated laparoscopically were not different in age from patients undergoing conventional surgery (Weighted Mean Difference (WMD): 0.20 [95% CI -1.04 to 1.43; p = 0.75) (Comparison: 01.02).

2) Intraoperative data
Operative time was estimated in 22 trials with 2992 participants. In none of all trials duration of surgery was signifcantly shorter in the laparoscopic group. Overall, the WMD was 42.4 minutes [95% CI 29.8 to 55.0; p < 0.0001]. Data for operative time varied considerably. The mean operative time in the laparoscopic groups ranged from 88 minutes to 275 minutes and in the conventional group from 60 to 188 minutes. Test for heterogeneity of the data was highly significant (p < 0.0001). (Comparison: 02.01)

Blood loss was a little less in laparoscopic than in conventional surgery with a WMD of -71.8cc (95% CI -113,0 to -30.8; p = 0.0006). Again, the variability in blood loss was quite high in the laparoscopic groups (58cc to 300cc) as well as in the conventional group (133cc to 407cc). Only one trial reported a higher blood loss in the laparoscopic group (173cc) compared to the conventional group (133cc) in patients undergoing surgery for Crohn's disease (Milsom 2001). The test for heterogeneity however was again highly significant (p < 0.0001). (Comparison: 02.02)

7 trials with 688 participants gave data on the number of retrieved lymphnodes in patients undergoing surgery for colorectal carcinoma. There was no difference in the number of retrieved lymphnodes between both groups (RR: 0.12 ([95% CI -1.17 to 1.41; p = 0.86]). There was not heterogeneity detected (p = 0.99). (Comparison: 02.03)

The length of the resected specimen was reported in 2 trials treating 134 cancer patients (Schwenk 2002; Winslow 2002). There was no diference between the laparoscopic and the conventional groups (WMD: 0.71 [95% CI -2.05 - 3.48; p = 0.61]). the test for heterogeneity showed no significant result (p = 0.30). (Comparison: 02.04)

3) Postoperative Pain
Pain perception on the first postoperative day was measured in 6 trials with 691 patients. On a visual analog scale from 0 (no pain) to 100 (extreme pain) the WMD between both groups was -9.3 (95% CI -13.2 to -5.4; p < 0.0001) in favour of the laparoscopic groups. There was no heterogeneity identified (p = 0.90). (Comparison: 03.01.01)

On postoperative day 2 pain perception was assessed in 6 trials with 719 patients. At this time no significant difference between both groups was detected (WMD -7.9 [95% CI -18.9 to 3.2, p = 0.16]). However, heterogeneity of the data was high (p = 0.0008). Most important, the trial by Weeks et al, that contributed 76.5% of all data for this item (Weeks 2002), did not show any difference in pain perception between the laparoscopic and the conventional group on the second postoperative day. (Comparison: 03.01.02)

On the third postoperative day only 3 trials including 175 patients assessed pain. The overall pain perception in these trials again showed a significant advantage for the laparoscopically treated patients. The WMD was -12.9 (95% CI -19.8 to - 6.0; p = 0.0002). No heterogeneity was detected for his item (p = 0.59). (Comparison: 03.01.03)

4) Postoperative pulmonary function
Postoperative pulmonary function was measured in only 5 trials (Braga 2002 a;Milsom 1998; Milsom 2001; Schwenk 2002; Stage 1997) . Milsom et al did not give absolute data for pulmonary function tests, but rather the time interval to return of 80% of preoperative function (Milsom 1998; Milsom 2001). On postoperative day 1, forced vital capacity (FVC) was better in 68 laparoscopic versus 63 conventional patients from 2 trials (Stage 1997; Schwenk 2002) (WMD 0.38l [95% CI 0,10 to 0,66; p < 0.008). (Comparison: 04.01.01)

On the second postoperative day, 3 trials with 210 patients showed no significant difference in FVC between both groups (WMD 0.5l [95% CI -0.62 - 0.72]). At this time one study did give a better pulmonary function for the conventional group (Braga 2002 a) while another trial showed a significant advantage for the laparoscopic group (Schwenk 2002) and the third trial did not show any difference at all between both groups (Stage 1997). Therefore, the heterogeneity of the data was high (p = 0.009) (Comparison: 04.01.02).

On day three, the two available trials with 131 participants (Schwenk 2002; Stage 1997) showed a significant benefit in FVC for the laparoscopic group (WMD 0.56l [95% CI 0.21 to 0.92; p = 0.002]) (Comparison: 04.01.03).

Milsom et al (Milsom 1998) described that more than half of their laparoscopic patients reached 80% of preoperative FVC within 3 postoperative days, while it took 6 days for the participants from the conventional group to reach the same goal. The same group (Milsom 2001) was not able to show any faster recovery of pulmonary function after laparoscopic surgery for Crohn's disease (2.5 days) compared to conventional surgery (2.5days). (Comparison: 04.02)

5) Duration of postoperative ileus
Duration of postoperative ileus was assessed in 8 studies including 1116 patients by measuring the time interval between surgery and the first passing of flatus. Overall, this goal was reached 1.0 days earlier by the laparsocopic patients than by the patients from the conventional groups (WMD 1.03 [95% CI -1.30 to -0.76; p < 0.0001]). (Comparison: 05.01.01)

In 9 trials (1130 participants) the duration of postoperative ileus was measured by the time interval between surgery and the first bowel movement. Overall, in these studies the duration of ileus was 0.9 days shorter in the laparoscopic group (WMD -0.93 [95% CI -1.13 to - 0.74; p < 0.0001]). Heterogeneity was not detected for both measurements of duration of postoperative ileus (each p > 0.05) (Comparison: 05.01.02).

6) Postoperative hospital stay
16 trials including 2544 participants gave data concerning the postoperative hospital stay. Overall, postoperative hospital stay was 1.5 days shorter in the laparoscopic group (WMD -1.53 [95% CI -1.94 to -1.12; p < 0.0001]). Variability of postoperative hospital stay was quite high with a mean postoperative stay reaching from 3.9 to 10.4 days in the laparoscopic arms and from 6 to 12.7 days in the conventional arms of the trials. However, none of the individual trials showed a significantly shorter postoperative hospital stay for patients undergoing conventional surgery compared to those undergoing laparoscopic surgery. Heterogeneity of data was not detected (p = 0.61) (Comparison: 06.01).

7) Quality of Life
Postoperative Quality of Life was assessed only by two trials (Schwenk 2002; Weeks 2002). Both trials used different instruments to measure QL. 7 and 30 days after surgery Schwenk et al found an advantage for 30 patients after laparoscopic compared to 30 patients who underwent conventional surgery (p = 0.06 and p = 0.01). 60 days after surgery the pooled data from two studies (509 patients) failed to show any advantage for the laparoscopic or the conventional technique (Schwenk 2002; Weeks 2002) (WMD: 0.48 [95% CI -8.73 to 9.69; p = 0.92]) (Comparison 07.01.01 to 07.01.03).

8) Total Morbidity
In 20 trials including 2879 participants overall morbidity was 20.6%. The incidence of postoperative complications was lower in the laparoscopic group (18.2%) compared to the conventional group (23.0%). The overall RR was 0.72 (95% CI 0.55 to 0.95; p = 0.02). To prevent one postoperative complication 21 patients would have to be treated laparoscopically (NNT = 20.8). (Comparison: 08.01)

9) Surgical Morbidity
Surgical morbidity was reported in 16 trials with 1688 participants. Overall surgcial morbidity was 12.7% (215 patients). Surgical complications were observed more often after conventional than after laparoscopic surgery (141/838 vs. 74/850 events: RR 0.55 [95% CI 0.39 to 0.77; p = 0.0005]). The NNT to prevent surgical morbidity was 12.4 (Comparison: 09.01).

Data on wound infections was given by 17 trials including 1771 patients. Wound infections were less often observed in laparoscopic patients (41/887; 4.6%) than in conventional patients (77/884; 8.7%). The RR was 0.56 (95% CI 0.39 to 0.81; p = 0.002). To prevent one wound infection 24 patients would have to be treated laparoscopically (NNT = 24.4) (Comparison: 09.02).

Intraabdominal abcesses were observed only in 5 of the 16 trials including 1688 patients. The incidence of an intraabdominal abcsess was not different between the laparoscopic groups (8/850; 0.9%) and the conventinal groups (11/838; 1.3%)(RR 0.71 [95%CI 0.28 to 1.80; p = 0.47]) (Comparison: 09.03).

17 trials including 1767 participants gave data concerning anastomotic insufficiencies. The overall leackage rate was 2.0% (35/1767). There was no difference in the leakage rate between the laparoscopic and the conventional groups (RR 0.59 [95%CI 0.02 to 1.16; p = 0.13]) (Comparison: 09.04).

Postoperative ileus appeared less frequent in the laparoscopic groups (15/887; 1.7%) than in the conventional groups (41/887; 4.6%) in 17 trials.The RR for the developement of a postoperative ileus was 0.40 (95% CI 0.22 to 0.73; p = 0.003) in favour of the laparoscopic technique. The NNT was 34.5 (Comparison: 09.05).

Postoperative bleeding was a rare event that occured only in 8 of 1688 patients (from 16 trials). As expected with this low incidence, there was no difference between the laparoscopic (2/850; 0.2%) and the conventional groups (6/838; 0.7%) (RR 0.44 [0.11 to 1.82; p = 0.26]) (Comparison: 09.06).

Only 2 (Lacy 2002; Milsom 2001) of 16 trials (1688 participants) reported postoperative disrupture of the wound fascia. All 3 reported cases of early postoperative fascial deshiscence occured after conventional surgery. Nevertheless, due to the low incidence of this complication, there was no difference between laparoscopic and conventional groups (RR 0.24 [95% CI 0.03 to 2.18; p = 0.20]) (Comparison: 09.07).

11 trials with 1292 patients gave data on the incidence of reoperation due to a surgical complication. This event occured in 59 patients (4.6%). Reoperation was not more likely to occur after laparoscopic (31/647; 4.8%) than after conventional surgery (28/645; 4.3%). The RR for reoperation was 1.16 (95% CI 0.67 to 1.99; p = 0.59) (Comparison: 09.08).

10) General Morbidity
General morbidity was quite low with 129 events in 1771 patients from 17 trials (7.3%). The difference in general morbidity between the laparoscopic groups (58/895; 6.5%) and the conventional groups (71/884; 8.0%) was not significant (RR 0.82 [95% CI 0.57 to 1.19; p = 0.30]) (Comparison: 10.01).

Data for pulmonary morbidity was available from 17 trials with 1771 patients. Pulmonary complications were observed in only 35 (2%) of all patients. Overall, there was no difference in the incidence of pulmonary complication between both groups (laparoscopic: 13/887, 1.5%; conventional: 22/884, 2.5%; RR: 0.69 [95% CI 0.35 - 1.35; p = 0.27]) (Comparison: 10.02).

Cardiac complications were reported from 25 of 1688 patients (1.5%) in 16 trials. There was no difference in cardiac morbidity between the laparoscopic and he conventional groups (RR 0.81 [95% CI 0.37 to 1.78; p = 0.60]) (Comparison: 10.03).

Urinary tract morbidity was reported on in 7 of 17 trials with a total f 1771 patients. There were no differences in the risk for a urinary tract infection between both groups (RR 0.87 [95% CI 0.41 to 1.85; p = 0.72]) (Comparison: 10.04).

Thrombosis of the deep venous system in the lower extremities was a rare event, diagnosed in 9 of 1688 patients from 16 trials (0.5%). The incidence of DVT was 0.35% (3/850) in the laparoscopic and 0.72% (6/838) in the conventional groups This difference between both groups was not significant (RR 0.76 ([95% CI 0.21 to 2.78; p = 0.68]) (Comparison: 10.05).

The only case of a pulmonary embolism was reported by Milsom 1998 for one patient undergoing laparoscopic resection. The overall incidence was 1 of 1688 (0.05%) for all patients and 1 of 850 (0.12%) for all laparoscopic patients (Comparison: 10.06).

11) Mortality
Data on postoperative mortality was available from 2394 participants from 17 trials. Only 6 trials reported postoperative deaths (Braga 2002 b; COST 2004; Lacy 2002; Leung 2004; Milsom 1998; Schwenk 2002). The overall mortality was 1.0% (23 patients). There was no difference in mortality between both groups (laparoscopic: 10/1207, 0.8%; conventional: 13/1187, 1.1%; RR 0.78 [95% CI -0.34 to 1.8; p = 0.55]) (Comparison: 11.01).

DISCUSSION

Short-term advantages of the laparoscopic compared to the conventional approach to colorectal resection have been suggested early after the first videoendoscopic colectomies had been performed (Franklin 1993; Jacobs 1991). Since 1996 25 randomised controlled trials have been published to answer the question, whether the laparoscopic approach to colorectal resection is superior to the conventional technique. This systematic

review of the literature with metaanalysis of randomised controlled trials is able to demonstrate certain advantages for the laparoscopic technique: blood loss is reduced (-72 cc), pain is less intense (-8 to -12 mm on a 100mm VAS for pain), pulmonary function is improved (0.38 to 0.56 l on postoperative day 1 and 3), duration of postoperative ileus is shorter (-1,0 day), postoperative duration of hospital stay is less (-1.4 days) and quality of life may be improved in the early postoperative course (10 points on a 0 - 100 scale on day 7, 14 points on day 30, not any more at day 60). Furthermore, the risk of postoperative morbidity is decreased by the laparoscopic approach (RR 0.72 [95% CI 0.55 - 0.95], namely because of a reduced surgical morbidity (exactly: wound infection [RR 0.56; 95% CI 0.39 - 0.82] and postoperative mechanical ileus [RR 0.42; 95% CI 0.24 - 0.75]). However, the incidence of general postoperative complications was not decreased by the laparoscopic approach (RR 0.85 [95% CI 0.61 - 1.18]).

These conclusions from this systematic review of randomised controlled trials is flawed by several problems:
1) the methodological quality of most included RCT is only moderate or poor,
2) even in methodologically excellent publications exact data on perioperative treatment is missing, especially import details of the conventional operative approach are not described in several trials,
3) data on how many patients were excluded from the trials because of contraindications to laparoscopic surgery is missing,
4) only very few and selected patients with rectal cancer (mostly patients undergoing high anterior resections for tumors in the upper rectum or APR for sphinkter infiltrating tumors) were included in the RCT published yet,
5) randomised controlled data on patients undergoing laparoscopic or conventional colectomy for inflammatory bowel disease (most import diverticular disease) can not be extracted from the published RCT and
6) perioperative treatment in many trials was very traditional and modern concepts of perioperative treatment (i. e. multimodal perioperative "fast-track"-management of patients (Kehlet 2000) were not followed in any of the trials analysed.

Some of these methodological issues will be solved by the still ongoing or not yet published multicenter trials from the UK (CLASSICC), Europe (COLOR) and Germany (LAPKON II). All these multicenter trials will include 500 - 1100 patients and the published descriptions of their study design show a high methodological quality for these trials (MRC-CLASSICC; COLOR). However, a large size RCT investigating the value of the laparoscopic approach to rectal cancer, especially the short-term outcome after laparoscopic compared to conventional rectal resection with TME is still missing. More import, there is no data from RCTs available concerning the most common indication for laparoscopic colonic resection in many industrialised countries: diverticular disease. Two multicenter RCT on these topics are planned right now: the COLOR 2-trial aims to evaluate the outcome of patients undergoing laparoscopic resection of rectal carcinoma (COLOR 2) while the LAPDIV-CAMIC-trial will investigate the value of laparoscopic sigmoidectomy for diverticular disease (LAPDIV-CAMIC).

Under traditional perioperative treatment, lapararoscopic colonic resections show clinically relevant advantages in selected patients. If the long-term oncological results of laparoscopic and conventional resection of colonic carcinoma show equivalent results, the laparoscopic approach should be preferred in patients suitable for this approach to colectomy. Furthermore, patients scheduled for elective resection of colonic cancer should be included into RCTs on short-term postoperative benefits of laparoscopic colectomy under optimized perioperative treatment (Kehlet 2000).

AUTHORS' CONCLUSIONS

Implications for practice

Under traditional perioperative treatment, lapararoscopic colonic resections show clinically relevant advantages in selected patients. If the long-term oncological results of laparoscopic ad conventional resection of colonic carcinoma show equivalent results, the laparoscopic approach should be preferred in patients suitable for this approach to colectomy.

Implications for research

Patients scheduled for elective resection of colonic cancer should be included into RCTs on short-term postoperative benefits of laparoscopic colectomy under optimized perioperative treatment.

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* Indicates the major publication for the study

CHARACTERISTICS OF STUDIES

Characteristics of included studies *[ordered by study ID]*

Braga 2002 a

Methods	RCT sample size calculation; preoperative randomisation; conversions did not occur.
Participants	n = 79 Inclusion: colorectal disease in the age > 18 years. Exclusion: > 80 years, emergency surgery, tumor below 4cm, adjacent organ infiltration, neoadjuvant radiochemotherapy, NYHA > class 3, respiratory dysfunction pO2 < 70 mm Hg, did not consent.
Interventions	laparoscopic vs. conventional Location: no data given. Conversions: no.

Braga 2002 a *(Continued)*

	Type of resection: right colon 6 vs. 7, left colon 19 vs. 18, rectal 15 vs. 14. Tumor stage: Dukes A 4 vs. 6, Dukes B 7 vs. 6, Dukes C 14 vs. 15.
Outcomes	Main study criterium: inflammatory response parameter. Data given for: operative time, pain analgetics, pulmonary function, duration of ileus, morbidity, hospital stay.
Notes	Laparoscopic technique: gas insufflation. Conventional incision: not stated. Anesthesia/Analgesia: standardized / thoracic epidural analgesia / systemic pca. Analgetic drugs: epidural ropivacaine / systemic morphine. Evans & Pollock: Design 36, Analysis 16, Presentation 15, Total 67.

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Low risk	A - Adequate

Braga 2002 b

Methods	RCT sample size calculation; preoperative randomisation; conversions analysed as intention to treat.
Participants	n = 269 Inclusion: elective colonic surgery in the age > 18 years. Exclusion: > 80 years, emergency surgery, tumor below 4cm, adjacent organ infiltration, cardiovascular reasons, infection, respiratory insufficiency (pO2 < 70 mm Hg), Child C hepatic insufficiency, neutropenia, refused informed consent.
Interventions	laparoscopic vs. conventional Conversions: narrow pelvis 3, adhesions 3, hypercapnia 1. Location: no data given. Type of resection: right colon 35 vs. 33, left colon 57 vs. 56, rectum 29 vs. 27. Tumor stage: Dukes A 13 vs. 15, Dukes B 24 vs. 25, Dukes C 47 vs. 52, Dukes D 6 vs. 4.
Outcomes	Main study criterium: 30-day-morbidity. Data given for: operative time, duration of ileus, morbidity, hospital stay, recovery of physical function.
Notes	Laparoscopic technique: gas insufflation. Conventional incision: not stated. Anesthesia/Analgesia: standardized / thoracic epidural analgesia / systemic pca. Analgetic drugs: epidural ropivacaine / systemic morphine. Evans & Pollock: Design 38, Analysis 18, Presentation 18, Total 72.

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Low risk	A - Adequate

COST 2004

Methods	RCT sample size calculation; randomisation preoperative; conversions analysed as intention-to-treat.
Participants	n = 863 Exclusion: adhesions, advanced local or metastatic disease, obstruction, perforation, severe medical illness, pregnancy, inflammatory bowel disease, FAP, concorrent or previous malignant tumors.
Interventions	laparoscopic vs. conventional Location: right sided colon 237 vs. 232, left sided colon 32 vs. 32, sigmoid 166 vs. 164.
Outcomes	Main study criterium: time to tumor recurrence. Data given for: operative time, postoperative hospital stay, morbidity, survival, recurrence rate.
Notes	Laparoscopic technique: gas insufflation. Conventional incision: not stated Anesthesia/Analgesia: not stated. Analgetic drugs: not stated. Evans & Pollock: Design 50, Analysis 25, Presentation 18, Total 93.

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Low risk	A - Adequate

Curet 2000

Methods	RCT no sample size calculation; randomisation reoperatively; conversions analysed seperately.
Participants	n = 36 Inclusion: colon cancer. Exclusion: <18 years, pregnancy, colonic obstruction, fixation or fistula to adjacent organs.
Interventions	laparoscopic vs. conventional. Location: ascending colon, descending colon, sigmoid, upper rectum. Conversions: tumor fixation 3, adhesions 3, abscess 1. Type of resection: right colon 6 vs 5, left colon 8 vs. 8, rectal 4 vs. 5. Tumor stage: UICC I 1 vs 0, UICC II 10 vs. 9, UICC III 7 vs. 5, UICC IV 0 vs. 4.
Outcomes	Main study criterium: not stated. Data given for: operative time, morbidity, hospital stay.
Notes	Laparoscopic technique: gas insufflation. Conventional incision: not stated. Anesthesia/Analgesia:not standardized, Analgetic drugs: not stated. Evans & Pollock: Design 17, Analysis 10, Presentation 5, Total 32.

Curet 2000 *(Continued)*

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Low risk	A - Adequate

Danelli 2002

Methods	RCT sample size calculation; randomisation preoperative; no conversions.
Participants	n = 44 Inclusion: elective colorectal resection. Exclusion: contraindications to epidural catheter placement, age < 18 or >75 years, obesity (BMI> 25 kg/m^2), allergies to local anesthetics or opioids, corticosteroid or chronic pain mediaction, unable to understand the use of patient controlled analgesia.
Interventions	laparoscopic vs. conventional Conversions: none. Tumor location: not stated. Type of resection: not stated.
Outcomes	Main study criterium: perioperative body core temperature. Data given for: body temperature, intraoperative heart rate, blood pressure, pain at rest and while coughing, time until flatus and defacation, first intake of clear liquids.
Notes	Laparoscopic technique: gas insufflation. Conventional incision: midline laparotomy Anesthesia/Analgesia: standardized thoracic epidural + systemic opiod pca; Analgetic drugs: ropivacaine for epidural, morphine pca, ketoprofen i.v. Evans & Pollock: Design 38, Analysis 13, Presentation 13, Total 64.

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Unclear risk	B - Unclear

Dunker 2002

Methods	RCT sample size calculation; randomisation preoperative; no conversions.
Participants	n = 30; Inclusion: colonic resection for inflammatory disease. Exclusion: blood transfusions.
Interventions	laparoscopic vs. conventional Conversions: none

Dunker 2002 *(Continued)*

	ileocecal resection for crohn's disease: 6 vs. 7, colectomy for colitis or FAP: 10 vs. 7
Outcomes	Main study criterium: inflammatory and immune response.
Notes	Laparoscopic technique: gas insufflation Conventional incision: not stated Analgetic drugs: not stated. Evans & Pollock: Design 28, Analysis 12, Presentation 12, Total 52.

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Unclear risk	B - Unclear

Hasegawa 2003

Methods	RCT no sample size calculation; randomisation preoperative; no conversion.
Participants	n = 50; Inclusion: T2 or T3 colorectal cancer (N0). Exclusion: Tis and T1 stage, upper and lower rectum, transverse colon, T4 tumors, liver metastasis, peritoneal dissemination.
Interventions	laparoscopic vs. conventional Conversions: none. Tumor location: cecum, ascending colon, descending colon, sigmoid, rectosigmoid. Type of resection: not stated.
Outcomes	Main study criterium: not stated. Data given for: operative time, blood loss, length of incision, cytokine levels (IL-6), CrP, NK-cell activity, duration of postoperative ileus, duration of additional analgetic requests, morbidity, postoperative hospital stay.
Notes	Laparoscopic technique: gas insufflation. Conventional incision: not stated Anesthesia/Analgesia: thoracic epidural, i.m. on demand. Analgetic drugs: epidural bupivacaine / morphine; additional pentazocine i.m. Evans & Pollock: Design 24, Analysis 9, Presentation 10, Total 43.

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Unclear risk	B - Unclear

Hewitt 1998

Methods	RCT,

Hewitt 1998 *(Continued)*

	sample size calculation; time of randomisation not stated; conversions excluded from analysis.
Participants	n = 15 Inclusion: Carcinoma. Exclusion: >80 yrs., previous abdominal surgery, rectal tumor < 10cm from anal verge, advanced local disease, metastatic disease, debilitating concurrent disease, immunomodulatory drugs, blood products within 6 months preoperative. Approximately 250 pts. excluded because of immunomodulatory drugs.
Interventions	laparoscopic vs. conventional Conversions: wrong tumor location 1. Type of resection: left colon 4 vs. 5, rectal 3 vs. 3, segmental 1 vs. 0. Tumor stage: Dukes A 1 vs. 1 Dukes B 3 vs. 3 Dukes C 4 vs. 4
Outcomes	Main study criterium: "immunology". Data given for: operative time, analgetics, morbidity, hospital stay
Notes	Operative technique: gas insufflation. conventional incision: not stated. Anesthesia/Analgesia: standardized, systemic on demand or pca. drugs: pethidin or morphine. Evans & Pollock: Design 12, Analysis 13, Presentation 10, Total 35.

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Unclear risk	B - Unclear

Hildebrandt 2003 a

Methods	RCT no sample size calculation; randomisation preoperative; no conversions.
Participants	n = 22 Inclusion: adenoma or carcinoma of right or left hemicolon Exclusion: Crohn's related sepsis, abscess, acute obstruction, fistula, steroid medication.
Interventions	laparoscopic vs. conventional Conversions: none. Tumor location: sigmoid, right colon. Type of resection: right hemicolectomy 4 vs. 4, sigmoid resection 7 vs. 7.
Outcomes	Main study criterium: not stated. Data given for: operative time, cytokine levels (IL-6, IL-10), CrP, granulocyte elastase, no further clinical data.
Notes	Laparoscopic technique: gas insufflation. Conventional incision: midline laparotomy Anesthesia/Analgesia: no stated; Analgetic drugs: not stated. Evans & Pollock: Design 26, Analysis 12,

Hildebrandt 2003 a *(Continued)*

	Presentation 8, Total 46.

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Unclear risk	B - Unclear

Hildebrandt 2003 b

Methods	RCT no sample size calculation; randomisation preoperative; no conversions.
Participants	n = 20 Inclusion: Crohn's disease. Exclusion: Crohn's related sepsis, abscess, acute obstruction, fistula, steroid medication.
Interventions	laparoscopic vs. conventional Conversions: none. Type of resection: ileocecal resection 2 vs. 2, right hemicolectomy 2 vs. 2, anastomotic resection 3 vs. 3, segmental colonic resection 2 vs. 2, small bowel 1 vs. 1.
Outcomes	Main study criterium: not stated. Data given for: operative time, cytokine levels (IL-6, IL-10), CrP, granulocyte elastase, no further clinical data.
Notes	Laparoscopic technique: gas insufflation. Conventional incision: midline laparotomy Anesthesia/Analgesia: no stated; Analgetic drugs: not stated. Evans & Pollock: Design 26, Analysis 12, Presentation 8, Total 46.

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Unclear risk	B - Unclear

Janson 2004

Methods	RCT no sample size calculation; randomisation preoperative; conversions analysed as intention to treat.
Participants	n = 210 Exclusion: transverse colon cancer, rectal cancer, distant metastasis, BMI > 30 kg/m^2, previous malignant disease, pregnancy, fixed tumor, obstructing tumor.
Interventions	laparoscopic vs. conventional Conversions: 14.

Janson 2004 *(Continued)*

	Tumor location: ascending colon, descending colon, sigmoid Type of resection: right colon 51 vs 57, left colon 43 vs. 50. tumor stage: UICC I 18 vs. 27, UICC II 44 vs. 45, UICC III 36 vs. 40.
Outcomes	Main study criterium: total costs to the society Data given for: operative time, morbidity, hospital stay.
Notes	laparoscopic technique: gas insufflation. Conventional incision: not stated Anesthesia/Analgesia: not thoracic epidural, i.m. on demand Analgetic drugs: epidural bupivacaine / morphine; additional pentazocine i.m. Evans & Pollock: Design 36, Analysis 20, Presentation 15, Total 71.

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Unclear risk	D - Not used

Lacy 2002

Methods	RCT sample size calculation; preoperative randomisation; conversions analysed as intention to treat.
Participants	n = 219 Inclusion: Adenocarcinoma above 15cm from the anal verge. Exclusion: intestinal obstruction, adjacent organ infiltration, transverse colon cancer, distant metastasis, past colonic surgery, no consent.
Interventions	laparoscopic vs. conventional Location: ascending colon, colonic flexures, descending colon, sigmoid colon, upper rectum. Conversions: adjacent organ infiltration 15. Type of resection: right colon 49 vs. 49, left colon 58 vs. 48, rectal 3 vs. 9, extended resection 1 vs. 2. Tumor stage: UICC I 26 vs. 18, UICC II 42 vs. 48, UICC III 37 vs.36, UICC IV 5 vs. 6.
Outcomes	Main study criterium: cancer related survival. Data given for: operative time, duration of ileus, morbidity, hospital stay.
Notes	Laparoscopic technique: gas insufflation. Conventional incision: not stated. Anesthesia/Analgesia: not stated. Analgetic drugs: not stated. Evans & Pollock: Design 41, Analysis 14, Presentation 17, Total 72.

Risk of bias

Bias	Authors' judgement	Support for judgement

Lacy 2002 *(Continued)*

Allocation concealment?	Low risk	A - Adequate

Leung 2000

Methods	RCT sample size calculation; preoperative randomisation; conversions analysed as intention to treat.
Participants	n = 34 Inclusion: rectosigmoid carcinoma. Exclusion: tumor < 5cm from dentate line intestinal obstruction, tumor infiltration of adjacent organs, tumor > 6cm in diameter, previous abdominal surgery, intestinal perforation, did not consent.
Interventions	laparoscopic vs. conventional Location: sigmoid colon, upper rectum. Conversions: surgical emphysema 1. Type of resection: rectosigmoid 17 vs. 17. Tumor stage: UICC I 0 vs. 0, UICC II 10 vs. 9, UICC III 7 vs. 8.
Outcomes	Main study criterium: cytokine and CrP. Data given for: operative time, pain, analgetics, duration of ileus morbidity, hospital stay.
Notes	Laparoscopic technique: gas insufflation. Conventional incision: not stated. Anesthesia/Analgesia: standardized / on demand; Analgetic drugs: pethidine. Evans & Pollock: Design 27, Analysis 13, Presentation 15, Total 55.

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Allocation concealment?	Unclear risk	B - Unclear

Leung 2004

Methods	RCT sample size calculation; randomisation preoperative; conversions analysed as intention to treat.
Participants	n = 406 Exclusion: tumors needing anastomosis < 5cm of dentate line, diameter > 6cm, infiltration of adjacent organs, previous abdominal surgery, no consent, obstruction, perforation.
Interventions	laparoscopic vs. conventional Location: sigmoid, upper rectum. Conversions: 47.
Outcomes	Main study criterium: 5-year-survival Data given for: operative time,

Leung 2004 *(Continued)*

	pain, analgetic requirements, duration of ileus, postoperative hospital stay, morbidity, mortality, survival.
Notes	Laparoscopic technique: gas insufflation. Conventional incision: not stated. Anesthesia/Analgesia: no epidural catheter, systemic on demand Analgetic drugs: pethidine or morphine Evans & Pollock: Design 40, Analysis 23, Presentation 17, Total 71.

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Unclear risk	B - Unclear

Liang 2002

Methods	RCT no sample size calculation; preoperative randomisation; no conversions.
Participants	n = 39 Inclusion: complex sigmoid polyps that could not be removed endoscopically. Exclusion: not stated.
Interventions	laparoscopic vs. conventional Conversions: none. Location: sigmoid. Type of resection: segmental resection of sigmoid 18 vs. 21. Tumor stage: Adenoma 14 vs. 16, UICC Stage I 4 vs. 4.
Outcomes	Main study criterium: not stated. Data given for: operative time, duration of ileus, hospital stay, pain, length of incision, morbidity, diability, inflammatory/immunological parameter (CrP, ESR, lymphocyte count, CD4/CD8-ratio).
Notes	Laparoscopic technique: gas insufflation. Conventional incision: not stated. Anesthesia/Analgesia: not stated. Analgetic drugs: not stated. Evans & Pollock: Design 24, Analysis 16, Presentation 13, Total 53.

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Unclear risk	B - Unclear

Milsom 1998

Methods	RCT sample size calculation; intraoperative randomisation after diagnostic laparoscopy;

Milsom 1998 *(Continued)*

	conversions analysed as intention to treat
Participants	n = 109 Inclusion: right sided or sigmoid cancer, upper rectal cancer, lower rectal cancer requiring APR. Exclusion: emergency or urgent surgery, disseminated disease, infiltration of adjacent organs, tumor > 8cm in diameter, transverse or descending colon tumors, midrectal tumors, BMI > 32 kg/m^2, declined to participate, dense adhesions, bowel distension, pregnancy, cardiovascular problems, refusal of insurance to pay for laparoscopic surgery
Interventions	laparoscopic vs. conventional Conversions: adhesions 4. Tumor location: ascending colon, sigmoid, upper rectum, lower rectum. Type of resection: right colon 29 vs. 26, left colon and ant. rectal resection 19 vs. 24, APR 7 vs. 4. Tumor stage: UICC I 10 vs. 9, UICC II 13 vs. 11, UICC III 16 vs. 14, UICC IV 3 vs. 4.
Outcomes	Main study criterium: pulmonary function. Data given for: operative time, analgetics, duration of ileus, morbidity, hospital stay.
Notes	Laparoscopic technique: gas insufflation. Conventional incision: midline incision. Anesthesia/Analgesia: standardized, systemic pca; Analgetic drugs: morphine. Evans & Pollock: Design 33, Analysis 23, Presentation 18, Total 74.

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Unclear risk	B - Unclear

Milsom 2001

Methods	RCT sample size calculation; intraoperative randomisation after diagnostic laparoscopy; conversions excluded from analysis.
Participants	n = 60 Inclusion: Crohn's disease limited to ileum and cecum, ASA I-III. Exclusion: declined consent, multiple adherent small bowel loops, extensive retroperitoneal inflammation.
Interventions	laparoscopic vs. conventional Conversions: adhesions 2. Type of resection: right colon (ileocecal) 31 vs. 29.
Outcomes	Main study criterium: pulmonary function. Data given for: operative time, analgetics, duration of ileus, morbidity, hospital stay.
Notes	Laparoscopic technique: gas insufflation. Conventional incision: lower midline incision . Anesthesia/Analgesia: standardized, systemic pca; Analgetic drugs: morphine. Evans & Pollock: Design 34, Analysis 19,

Milsom 2001 *(Continued)*

	Presentation 18, Total 71.

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Unclear risk	B - Unclear

Ortiz 1996

Methods	RCT no sample size calculation; preoperative randomisation; conversions excluded from analysis.
Participants	n = 30 Inclusion: carcinoma, diverticular disease, volvolus, ulcerative colitis, FAP. Exclusion: obstructing tumors, bulky cancers, rectum above 2cm, overweight, previous colonic surgery.
Interventions	laparoscopic vs. conventional Conversions: adhesions 5. Tumor location: sigmoid colon, upper rectum, rectum below 2cm. Type of resection: left colon 3 vs. 4; anterior rectal resection 7 vs. 6; APR 4 vs. 4; colectomy 1 vs. 1. Tumor stage: not stated.
Outcomes	Main study criterium: duration of ileus. Data given for: operative time, duration of ileus, morbidity.
Notes	Laparoscopic technique: not stated. Conventional incision:not stated. Anesthesia/Analgesia: not stated; Analgetic drugs: not stated. Evans & Pollock: Design 26, Analysis 3, Presentation 8, Total 37

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Unclear risk	B - Unclear

Schwenk 2002

Methods	RCT sample size calculation; randomisation intraoperative; conversions analysed as intention to treat.
Participants	n = 103 Inclusion: tumor of the right colon, sigmoid colon, rectum above 12 cm from anal verge or infiltrating the anal sphinkter, age 18 years or older Exclusion: tumors or fthe transverse colon or the rectum below 12cm (requiring anterior resection and TME), infiltration of adjacent organs, tumor diameter > 8cm in CT, liver metastasis eligible for simulta-

Schwenk 2002 *(Continued)*

	neous resection, ileus abscess or sepsis, BMI > 32kg/m^2, ASA IV - V, uncorrectable coagulopathy, neuromuscular disorders, chronic analgetic therapy, disorders of the immunologic system, pregnancy.
Interventions	laparoscopic vs. conventional Conversions: infiltration of ovary 1, technical problems unable to maintain pneumoperitoneum 1. Location: right colon9 vs. 7, left colon/sigmoid 27 vs. 28, upper rectum 13 vs. 11, lower rectum 4 vs. 3 Type of resection: right hemicolectomy 9 vs. 7, left hemicolectomy 0 vs. 2, sigmoid resection 27 vs 26, anterior rectal resection 13 vs. 11, APR 4 vs. 3. Tumor stage: UICC Stage 0 (adenoma) 3 vs. 3, Stage I 16 vs. 12, Stage II 20 vs. 11, Stage III 12 vs. 17, Stage IV 2 vs. 6.
Outcomes	Main study criterium: pulmonary function. Data given for: operative time, pain, analgetic requirements, duration of ileus, morbidity, hospital stay, fatigue, quality of life .
Notes	Laparoscopic technique: gas insufflation. Conventional incision: midline incision. Anesthesia/Analgesia: standardized / systemic opioid-pca. Analgetic drugs: morphine. Evans & Pollock: Design 24, Analysis 13, Presentation 18, Total 55.

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Low risk	A - Adequate

Solomon 2002

Methods	RCT sample size calculation; time of randomisation not stated; conversions analysed as intention to treat.
Participants	n = 39 Inclusion: full thickness rectal prolaps Exclusion: concomitant gynecological surgery, previous rectopexy, indication for perineal proctosigmoidectomy, obstructive defecation, concomitant rectocele, anal mucosal prolaps.
Interventions	laparoscopic vs. conventional Location: rectum. Conversions: refused conventional surgery converted to laparoscopy: 1. Type of resection: no resection, only rectopexy with mesh. Tumor stage: only benigne disease.
Outcomes	Main study criterium: subjective clinical outcome or objective stress response. Data given for: operative time, pain, analgetic dose, morbidity, hospital stay.
Notes	Laparoscopic technique: gas insufflation. Conventional incision: not stated. Anesthesia/Analgesia: not stated / pca. Analgetic drugs: morphine. Evans & Pollock: Design 35, Analysis 17, Presentation 15, Total 67.

Solomon 2002 *(Continued)*

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Unclear risk	B - Unclear

Stage 1997

Methods	RCT no sample size calculation; preoperative randomisation; conversions excluded from analysis.
Participants	n = 29 Inclusion: malignant colonic disease. Exclusion: extensive local tumor growth, low anterior resection, APR. Conversion: extensive tumor growth 3.
Interventions	laparoscopic vs. conventional Conversions: extensive tumor growth 3. Tumor location: ascending colon, right colonic flexure, left colonic flexure, descending colon, sigmoid. Type of resection: right colon 7 vs. 7, left colon 8 vs. 8. Tumor stage: Dukes A 3 vs. 4, Dukes B 8 vs. 4, Dukes C 2 vs. 2, Dukes D 2 vs. 4.
Outcomes	Main study criterium: not stated. Data given for: operative time, pain, pulmonary function, morbidity, hospital stay.
Notes	Laparoscopic technique: gas insufflation. Conventional incision: midline or paramedian. Anesthesia/Analgesia: standardized thoracic epidural + systemic on demand; Analgetic drugs: bupivacaine/morphine for epidural, morphine or ketobemidone i.m. on request. Evans & Pollock: Design 31, Analysis 13, Presentation 15, Total 59.

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Unclear risk	B - Unclear

Tang 2001

Methods	RCT sample size calculation; preoperative randomisation ; conversions excluded from analysis.
Participants	n = 236 Inclusion: colorectal cancer scheduled for left hemicolectomy, sigmoidectomy, anterior rectal resection or APR.

Tang 2001 *(Continued)*

	Exclusion: <18 years, tumor in transverse colon, pregnancy, contraindication to pneumoperitoneum, intestinal obstruction, malignancy within previous 5 yrs., synchronous multiple carcinoma, benign tumor.
Interventions	laparoscopic vs. conventional Tumor location: ascending colon, sigmoid colon, rectum. Conversions: reasons not stated 15. Type of resection: left colon 5 vs. 6, sigmoid and rectum 98 vs. 102; other 6 vs. 3. Tumor stage: UICC I 9 vs 80, UICC II 45 vs. 50, UICC III 42 vs.43, UICC IV 14 vs.11.
Outcomes	Main study criterium: immune and stress response. Data given for: operative time, morbidity.
Notes	Laparoscopic technique: gas insufflation. Conventional incision: type not stated. Anesthesia/Analgesia: not stated; Analgetic drugs: not stated. Evans & Pollock: Design 26, Analysis 8, Presentation 15, Total 49.

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Unclear risk	B - Unclear

Weeks 2002

Methods	RCT sample size calculation; preoperative randomisation; conversions analysed as intention to treat.
Participants	n = 449 Inclusion: adenocarcinoma involving a single segment. Exclusion: tumor < 5cm previous malignant tumor, transverse or rectal cancer, acute obstructed or perforated cancer, metastatic disease known preoperatively, adhesions, advanced local disease precluding lap. surgery, ASA IV-V, no malignant disease, non english speaking, no telephone, refused to participate.
Interventions	laparoscopic vs. conventional Tumor location: not stated. Conversions: advanced disease 11, positive margins 3, inability to visualize critical structures 10, inability to mobilize colon 4, adhesions 12. Type of resection: not stated. Tumor stage: UICC I 88 vs. 69, UICC II 77 vs. 78, UICC III 57 vs.62, UICC IV 5 vs. 11.
Outcomes	Main study criterium: Quality of life. Data given for: pain, hospital stay.
Notes	Laparoscopic technique: gas insufflation. Conventional incision: not stated. Anesthesia/Analgesia: not standardized / on demand, i.v., i. m., epidural. Analgetic drugs: not stated. Evans & Pollock: Design 27, Analysis 13,

Weeks 2002 *(Continued)*

	Presentation 15, Total 55.

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Unclear risk	B - Unclear

Winslow 2002

Methods	RCT no sample size calculation; preoperative randomisation; conversions included into the conventional group.
Participants	n = 83 Inclusion: adenocarcinoma of the right, left or sigmoid colon, age 18 years or older able to participate in follow-up examinations Exclusion: prohibitive scars from previous abdominal surgery, advanced local disease, stage IV colon cancer, rectal cancer, acutely perforated or obstruting cancers, cancers of the transverse colon, ASA class IV or V, associated gastrointestinal disease requiring surgery, concurrent or previous malignant tumor within 5 years (excluding nonmelanoma skin cancers), pregnancy.
Interventions	laparoscopic vs. conventional Conversions: 7, included in the conventional group. Tumor location: right, left or sigmoid colon. Type of resection: not stated.
Outcomes	Main study criterium: wound complications Data given for: operative time, length of incision, morbidity, wound complications including hernia, follow-up data.
Notes	Laparoscopic technique: gas insufflation. Conventional incision: midline laparotomy Anesthesia/Analgesia: not stated; Analgetic drugs: not stated. Evans & Pollock: Design 29, Analysis 12, Presentation 13, Total 54.

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Unclear risk	B - Unclear

Wu 2002

Methods	RCT no sample size calculation; preoperative randomisation; no conversions.
Participants	n = 26

Wu 2002 *(Continued)*

	Inclusion: colorectal cancer scheduled for left hemicolectomy, sigmoidectomy, anterior rectal resection or APR. Exclusion: <18 years, tumor in transverse colon, pregnancy, contraindication to pneumoperitoneum, intestinal obstruction, malignancy within previous 5 yrs., synchronous multiple carcinoma, begnin tumor.
Interventions	laparoscopic vs. conventional Tumor location: right colon, sigmoid colon. Type of resection: right colectomy 6 vs. 8, sigmoidectomy 6 vs. 6. Astler-Coller-Stage: A 0 vs. 0, B 2 vs. 10, C 10 vs. 4.
Outcomes	Main study criterium: inflammatory response and immunologic consequences. Data given for: operative time, hospital stay.
Notes	Laparoscopic technique: gas insufflation. Conventional incision: not stated. Anesthesia/Analgesia: not stated; Analgetic drugs: not stated. Evans & Pollock: Design 18, Analysis 12, Presentation 12, Total 42.

Risk of bias

Bias	Authors' judgement	Support for judgement
Allocation concealment?	Unclear risk	B - Unclear

RCT = randomised controlled trial; NYHA = New York Heart Association; pca = patient controlled analgesia; UICC = Union International de Classification de Cancre; BMI = Body Mass Index; IL = Interleukin; CrP = C-reactive protein; NK-cell = Natural Killer-cell; ESR = erythrocyte sedimentation rate; APR = abdominoperineal resection; ASA = American Society of Anesthesiologists; TME = total mesorectal excision.

Characteristics of excluded studies *[ordered by study ID]*

Study	Reason for exclusion
Bergamaschi 2000	RCT; comparing anastomosis using a left lower quadrant incision and reestablishment of the pneumoperitoneum vs. suprapubic incision and anastomosis under direct view in laparoscopic surgery.
Böhm 1999	Patients are included in Schwenk (2002), manuscript does not give any clinical data.
Delgado 2001	Patients and data are included in Lacy (2002).
Hotokezaka 1996	Pseudorandomisation; patients with strong preference for one approach over the other were assigned to that group.
Kim 1998	RCT; no clincal data concerning the objective of the review given (main study criterion: amount of tumor cells in peritoneal lavage before and after resection).
Lacy 1995	Patients and data are included in Lacy (2002).
Lacy 1998	RCT on port side metastasis and recurrence. Patients and data included in Lacy (2002).
Ordemann 2001	Patients and data are included in Schwenk (2002), no clincal data given.
Schulze 1999	RCT; comparing capnoperitoneum and gasless laparoscopic surgery.

Study	Reason for exclusion
Schwenk 1998 a	Patients and data are included in Schwenk (2002).
Schwenk 1998 b	Patients and data are included in Schwenk (2002).
Schwenk 1998 c	Patients and data are included in Schwenk (2002).
Schwenk 1999	Patients and data are included in Schwenk (2002).
Targarona 2002	RCT comparing hand-assisted laparoscopic colonic resection (HALS) and laparoscopic colonic resection.

Characteristics of ongoing studies *[ordered by study ID]*

COLOR

Trial name or title	conventional or laparoscopic resection of colonic cancer (COLOR)
Methods	
Participants	1100 patients
Interventions	laparoscopic vs. conventional resection of colonic cancer
Outcomes	Main study criterion: cancer free survival and recurrence rate. Other parameter: morbidity and mortality, Quality of Life in subgroup
Starting date	1997
Contact information	Hazebroek EJ. University Hospital Rotterdam-Dijkzigt, Department of Surgery, Rotterdam, The Netherlands
Notes	Patient recruitment terminated after 1100 patients in 2004, follow-up period ungoing

COLOR 2

Trial name or title	Conventional or laparoscopic resection of rectal cancer (COLOR 2)
Methods	
Participants	no further information available
Interventions	laparoscopic vs. conventional resection of rectal cancer
Outcomes	no further information available
Starting date	no further information available
Contact information	no further information available
Notes	

LAPDIV-CAMIC

Trial name or title	Prospective, randomised multicenter trial on short- and median term outcome after laparoscopic and conventional sigmoid resection for diverticular disease. (LAPDIV-CAMIC)
Methods	
Participants	600 participants planned
Interventions	laparoscopic vs. conventional sigmoidectomy
Outcomes	Main study criterion: Quality of Life Other study criteria: morbidity and mortality, postoperative pain perception, incidence of incisional hernia
Starting date	01.02.2005
Contact information	Schwenk W. Department of General-, Visceral-, Vascular-, and Thoracic Surgery Charité Campus Mitte, Berlin Germany
Notes	

LAPKON II

Trial name or title	Prospective-randomised multicenter trial on the long-term results of laparoscopic or conventional resection of colorectal cancer (LAPKON II)
Methods	
Participants	Sample size: 900. Recruitment terminated after ~ 600 patients
Interventions	laparoscopic vs. conventional resection of colorectal cancer
Outcomes	Main study criterion: local recurrence after 3 years, survival after 5 years. Other parameters: Morbidity, Mortality, incidence of incisional hernia,
Starting date	1998
Contact information	Schwenk W. Department of General-, Visceral-, Vascular-, and Thoracic Surgery Charité Campus Mitte, Berlin Germany
Notes	Patient recruitment terminated 01.10.2004.

MRC-CLASSICC

Trial name or title	Conventional versus Laparoscopic-assisted Surgery in Colorectal Cancer (CLASSICC)
Methods	
Participants	Sample size calculation: 1000 patients. Recruted: 420

MRC-CLASSICC *(Continued)*

Interventions	laparoscopic vs. conventional resection of colorectal cancer
Outcomes	Main study criterion: 3-year-survival, local recurrence rate, 30-day mortality. Other parameters: Quality of Life, cost effectiveness
Starting date	1996
Contact information	Stead ML. Northern and Yorkshire Clinical Trials and Research Unit, University of Leeds, Leeds; UK.
Notes	

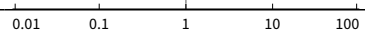
DATA AND ANALYSES

Comparison 1. Patient characteristics

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Female Sex	25	3416	Risk Ratio (M-H, Random, 95% CI)	1.05 [0.98, 1.13]
2 Age	25	3497	Mean Difference (IV, Random, 95% CI)	0.19 [-1.04, 1.42]

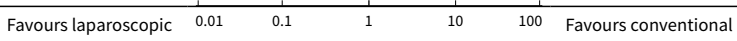
Analysis 1.1. Comparison 1 Patient characteristics, Outcome 1 Female Sex.

Study or subgroup	Laparoscopic n/N	Conventional n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
Braga 2002 a	24/40	14/39		1.99%	1.67[1.02,2.73]
Braga 2002 b	67/136	63/133		7.79%	1.04[0.81,1.33]
COST 2004	212/435	220/428		26.81%	0.95[0.83,1.08]
Curet 2000	7/18	4/18		0.44%	1.75[0.62,4.95]
Danelli 2002	13/23	10/21		1.45%	1.19[0.67,2.11]
Dunker 2002	11/16	6/14		1%	1.6[0.81,3.2]
Hasegawa 2003	10/24	8/26		0.86%	1.35[0.64,2.86]
Hewitt 1998	4/8	5/8		0.62%	0.8[0.33,1.92]
Hildebrandt 2003 a	4/11	6/11		0.53%	0.67[0.26,1.72]
Hildebrandt 2003 b	5/10	5/10		0.62%	1[0.42,2.4]
Janson 2004	47/98	55/112		6.1%	0.98[0.74,1.29]
Lacy 2002	55/111	58/108		7.23%	0.92[0.71,1.19]
Leung 2000	11/17	7/17		1.07%	1.57[0.81,3.06]
Leung 2004	99/203	86/200		10.51%	1.13[0.92,1.4]
Liang 2002	8/18	8/21		0.84%	1.17[0.55,2.47]
Milsom 1998	29/55	18/54		2.33%	1.58[1.01,2.49]
Milsom 2001	18/31	17/29		2.6%	0.99[0.65,1.52]
Ortiz 1996	8/15	7/15		0.92%	1.14[0.56,2.35]
Schwenk 2002	26/53	25/49		3.17%	0.96[0.65,1.42]
Solomon 2002	0/20	0/19			Not estimable
Stage 1997	7/15	9/14		1.07%	0.73[0.37,1.41]



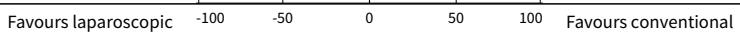
Favours laparoscopic — Favours conventional

Study or subgroup	Laparoscopic n/N	Conventional n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
Tang 2001	57/118	48/118		5.79%	1.19[0.89,1.58]
Weeks 2002	118/228	108/221		14.06%	1.06[0.88,1.27]
Winslow 2002	0/1	0/1			Not estimable
Wu 2002	10/12	9/14		2.2%	1.3[0.81,2.06]
Total (95% CI)	**1716**	**1700**		**100%**	**1.05[0.98,1.13]**
Total events: 850 (Laparoscopic), 796 (Conventional)					
Heterogeneity: Tau^2=0; Chi^2=19.36, df=22(P=0.62); I^2=0%					
Test for overall effect: Z=1.43(P=0.15)					



Analysis 1.2. Comparison 1 Patient characteristics, Outcome 2 Age.

Study or subgroup	Laparoscopic N	Laparoscopic Mean(SD)	Conventional N	Conventional Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
Braga 2002 a	40	65.3 (10.3)	39	62.4 (12.7)		5.8%	2.9[-2.21,8.01]
Braga 2002 b	136	63.7 (12.5)	133	65.2 (10.9)		19.27%	-1.5[-4.3,1.3]
COST 2004	435	70 (70)	428	69 (69)		1.76%	1[-8.27,10.27]
Curet 2000	18	65.6 (65.5)	18	69.2 (69.2)		0.08%	-3.6[-47.62,40.42]
Danelli 2002	23	64 (7.2)	21	62 (9.4)		6.09%	2[-2.98,6.98]
Dunker 2002	16	30 (30)	14	35.5 (35.5)		0.27%	-5.5[-29.2,18.2]
Hasegawa 2003	24	61 (61)	26	61 (61)		0.13%	0[-33.84,33.84]
Hewitt 1998	8	54 (54)	8	70 (70)		0.04%	-16[-77.26,45.26]
Hildebrandt 2003 a	11	55.2 (55.2)	11	65.9 (65.9)		0.06%	-10.7[-61.5,40.1]
Hildebrandt 2003 b	10	36.2 (36.2)	10	37.2 (37.2)		0.15%	-1[-33.17,31.17]
Janson 2004	98	71.1 (71.1)	112	69.4 (69.4)		0.42%	1.7[-17.36,20.76]
Lacy 2002	111	68 (12)	108	71 (11)		16.27%	-3[-6.05,0.05]
Leung 2000	17	67 (11.3)	17	66.9 (13.7)		2.12%	0.1[-8.34,8.54]
Leung 2004	203	67.1 (11.7)	200	66.5 (12.3)		27.5%	0.6[-1.74,2.94]
Liang 2002	18	63.8 (7.1)	21	58.2 (10.5)		4.89%	5.6[0.04,11.16]
Milsom 1998	55	69 (69)	54	69 (69)		0.23%	0[-25.91,25.91]
Milsom 2001	31	37 (37)	29	32 (32)		0.5%	5[-12.47,22.47]
Ortiz 1996	15	52 (52)	15	56 (56)		0.1%	-4[-42.67,34.67]
Schwenk 2002	53	63.6 (10.6)	49	63.6 (13.5)		6.74%	0[-4.74,4.74]
Solomon 2002	20	0 (0)	19	0 (0)			Not estimable
Stage 1997	15	72 (72)	14	73 (73)		0.05%	-1[-53.82,51.82]
Tang 2001	118	64 (64)	118	62 (62)		0.58%	2[-14.08,18.08]
Weeks 2002	228	68.2 (68.2)	221	69.4 (69.4)		0.93%	-1.2[-13.93,11.53]
Winslow 2002	37	69.4 (11.7)	46	65.7 (11.5)		5.98%	3.7[-1.33,8.73]
Wu 2002	12	66 (66)	14	69 (69)		0.06%	-3[-54.97,48.97]
Total ***	**1752**		**1745**			**100%**	**0.19[-1.04,1.42]**
Heterogeneity: Tau^2=0; Chi^2=14.03, df=23(P=0.93); I^2=0%							
Test for overall effect: Z=0.3(P=0.77)							



Comparison 2. Operative data

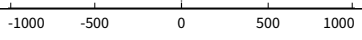
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Operative time	25	2998	Mean Difference (IV, Random, 95% CI)	42.42 [29.81, 55.03]
2 Blood loss	25	1333	Mean Difference (IV, Random, 95% CI)	-71.88 [-113.00, -30.76]
3 Number of Retrieved Lymphnodes	25	724	Mean Difference (IV, Random, 95% CI)	0.12 [-1.17, 1.41]
4 Length of Specimen	25	223	Mean Difference (IV, Random, 95% CI)	0.76 [-1.84, 3.36]

Analysis 2.1. Comparison 2 Operative data, Outcome 1 Operative time.

Study or subgroup	Laparoscopic N	Laparoscopic Mean(SD)	Conventional N	Conventional Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
Braga 2002 a	40	234 (74)	39	173 (56)		5.38%	61[32.11,89.89]
Braga 2002 b	136	222 (74)	133	177 (56)		6.72%	45[29.34,60.66]
COST 2004	435	150 (150)	428	95 (95)		6.63%	55[38.28,71.72]
Curet 2000	18	210 (210)	18	138 (138)		1.02%	72[-44.09,188.09]
Danelli 2002	23	244 (244)	21	160 (160)		0.95%	84[-36.94,204.94]
Dunker 2002	1	0 (0)	1	0 (0)			Not estimable
Hasegawa 2003	24	275 (275)	26	188 (188)		0.82%	87[-44.63,218.63]
Hewitt 1998	8	165 (165)	8	107.5 (107.5)		0.77%	57.5[-78.96,193.96]
Hildebrandt 2003 a	11	224.5 (14.4)	11	186.5 (22.4)		6.72%	38[22.26,53.74]
Hildebrandt 2003 b	10	144 (15)	10	155 (16)		6.9%	-11[-24.59,2.59]
Janson 2004	98	155 (155)	112	122 (122)		4.45%	33[-5.11,71.11]
Lacy 2002	111	142 (52)	108	118 (45)		6.96%	24[11.13,36.87]
Leung 2000	17	212.1 (64.9)	17	136.8 (51.9)		4.32%	75.3[35.8,114.8]
Leung 2004	203	189.9 (55.4)	200	144.2 (57.8)		7.09%	45.7[34.64,56.76]
Liang 2002	18	148 (51.5)	21	160 (28.6)		5.61%	-12[-38.75,14.75]
Milsom 1998	55	200 (40)	54	125 (51)		6.58%	75[57.77,92.23]
Milsom 2001	31	140 (45)	29	85 (21)		6.55%	55[37.41,72.59]
Ortiz 1996	15	294 (294)	15	180 (180)		0.49%	114[-60.45,288.45]
Schwenk 2002	53	216.9 (57.5)	49	151 (43.1)		6.35%	65.9[46.27,85.53]
Solomon 2002	20	153 (153)	19	102 (102)		1.82%	51[-30.24,132.24]
Stage 1997	15	150 (150)	14	95 (95)		1.53%	55[-35.77,145.77]
Tang 2001	118	88 (88)	118	70 (70)		6.28%	18[-2.29,38.29]
Weeks 2002	1	0 (0)	1	0 (0)			Not estimable
Winslow 2002	37	148 (47)	46	101 (57)		6.07%	47[24.62,69.38]
Wu 2002	1	0 (0)	1	0 (0)			Not estimable
Total ***	**1499**		**1499**			**100%**	**42.42[29.81,55.03]**

Heterogeneity: Tau²=551.63; Chi²=116.26, df=21(P<0.0001); I²=81.94%

Test for overall effect: Z=6.59(P<0.0001)



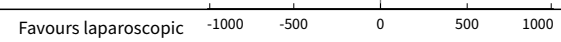
Favours laparoscopic — Favours conventional

Analysis 2.2. Comparison 2 Operative data, Outcome 2 Blood loss.

Study or subgroup	Laparoscopic		Conventional		Mean Difference	Weight	Mean Difference
	N	Mean(SD)	N	Mean(SD)	Random, 95% CI		Random, 95% CI
Braga 2002 a	40	123 (107)	39	319 (307)		8.4%	-196[-297.9,-94.1]
Braga 2002 b	136	170 (107)	133	286 (242)		14.39%	-116[-160.89,-71.11]
COST 2004	1	0 (0)	1	0 (0)			Not estimable
Curet 2000	18	284 (284)	18	407 (407)		2.71%	-123[-352.27,106.27]
Danelli 2002	23	300 (300)	21	300 (300)		4.1%	0[-177.47,177.47]
Dunker 2002	1	0 (0)	1	0 (0)			Not estimable
Hasegawa 2003	24	58 (58)	26	137 (137)		12.96%	-79[-136.55,-21.45]
Hewitt 1998	1	0 (0)	1	0 (0)			Not estimable
Hildebrandt 2003 a	1	0 (0)	1	0 (0)			Not estimable
Hildebrandt 2003 b	1	0 (0)	1	0 (0)			Not estimable
Janson 2004	1	0 (0)	1	0 (0)			Not estimable
Lacy 2002	111	105 (99)	108	193 (212)		14.48%	-88[-132.02,-43.98]
Leung 2000	17	103 (103)	17	141 (141)		10.17%	-38[-121,45]
Leung 2004	203	169 (169)	200	238 (238)		14.88%	-69[-109.35,-28.65]
Liang 2002	1	0 (0)	1	0 (0)			Not estimable
Milsom 1998	55	252 (222)	54	344 (626)		4.12%	-92[-268.97,84.97]
Milsom 2001	31	173 (123)	29	133 (70)		13.79%	40[-10.24,90.24]
Ortiz 1996	1	0 (0)	1	0 (0)			Not estimable
Schwenk 2002	1	0 (0)	1	0 (0)			Not estimable
Solomon 2002	1	0 (0)	1	0 (0)			Not estimable
Stage 1997	1	0 (0)	1	0 (0)			Not estimable
Tang 2001	1	0 (0)	1	0 (0)			Not estimable
Weeks 2002	1	0 (0)	1	0 (0)			Not estimable
Winslow 2002	1	0 (0)	1	0 (0)			Not estimable
Wu 2002	1	0 (0)	1	0 (0)			Not estimable
Total ***	**673**		**660**			**100%**	**-71.88[-113,-30.76]**

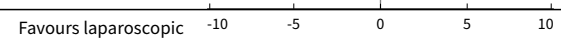
Heterogeneity: Tau²=2534.8; Chi²=30.49, df=9(P=0); I²=70.48%

Test for overall effect: Z=3.43(P=0)



Analysis 2.3. Comparison 2 Operative data, Outcome 3 Number of Retrieved Lymphnodes.

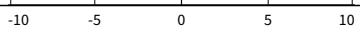
Study or subgroup	Laparoscopic		Conventional		Mean Difference	Weight	Mean Difference
	N	Mean(SD)	N	Mean(SD)	Random, 95% CI		Random, 95% CI
Braga 2002 a	25	17.7 (8.9)	27	18.1 (7)		8.65%	-0.4[-4.78,3.98]
Braga 2002 b	90	14.8 (7.6)	93	14.5 (7.2)		35.97%	0.3[-1.85,2.45]
COST 2004	1	0 (0)	1	0 (0)			Not estimable
Curet 2000	18	11 (11)	18	10 (10)		3.51%	1[-5.87,7.87]
Danelli 2002	1	0 (0)	1	0 (0)			Not estimable
Dunker 2002	1	0 (0)	1	0 (0)			Not estimable
Hasegawa 2003	1	0 (0)	1	0 (0)			Not estimable
Hewitt 1998	1	0 (0)	1	0 (0)			Not estimable
Hildebrandt 2003 a	1	0 (0)	1	0 (0)			Not estimable
Hildebrandt 2003 b	1	0 (0)	1	0 (0)			Not estimable
Janson 2004	1	0 (0)	1	0 (0)			Not estimable
Lacy 2002	111	11.1 (7.9)	108	11.1 (7.4)		40.33%	0[-2.03,2.03]
Leung 2000	1	0 (0)	1	0 (0)			Not estimable



Study or subgroup	Laparoscopic N	Laparoscopic Mean(SD)	Conventional N	Conventional Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
Leung 2004	1	0 (0)	1	0 (0)			Not estimable
Liang 2002	1	0 (0)	1	0 (0)			Not estimable
Milsom 1998	55	19 (0)	54	25 (0)			Not estimable
Milsom 2001	1	0 (0)	1	0 (0)			Not estimable
Ortiz 1996	1	0 (0)	1	0 (0)			Not estimable
Schwenk 2002	30	19.6 (12)	30	18.5 (8.4)		6.03%	1.1[-4.14,6.34]
Solomon 2002	1	0 (0)	1	0 (0)			Not estimable
Stage 1997	15	7 (7)	14	8 (8)		5.5%	-1[-6.49,4.49]
Tang 2001	1	0 (0)	1	0 (0)			Not estimable
Weeks 2002	1	0 (0)	1	0 (0)			Not estimable
Winslow 2002	1	0 (0)	1	0 (0)			Not estimable
Wu 2002	1	0 (0)	1	0 (0)			Not estimable
Total * **	**362**		**362**			**100%**	**0.12[-1.17,1.41]**

Heterogeneity: $Tau^2=0$; $Chi^2=0.45$, df=5(P=0.99); $I^2=0\%$

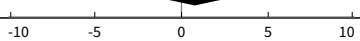
Test for overall effect: Z=0.18(P=0.86)



Favours laparoscopic — Favours conventional

Analysis 2.4. Comparison 2 Operative data, Outcome 4 Length of Specimen.

Study or subgroup	Laparoscopic N	Laparoscopic Mean(SD)	Conventional N	Conventional Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
Braga 2002 a	1	0 (0)	1	0 (0)			Not estimable
Braga 2002 b	1	0 (0)	1	0 (0)			Not estimable
COST 2004	1	0 (0)	1	0 (0)			Not estimable
Curet 2000	18	26 (26)	18	25 (25)		2.44%	1[-15.66,17.66]
Danelli 2002	1	0 (0)	1	0 (0)			Not estimable
Dunker 2002	1	0 (0)	1	0 (0)			Not estimable
Hasegawa 2003	1	0 (0)	1	0 (0)			Not estimable
Hewitt 1998	1	0 (0)	1	0 (0)			Not estimable
Hildebrandt 2003 a	1	0 (0)	1	0 (0)			Not estimable
Hildebrandt 2003 b	1	0 (0)	1	0 (0)			Not estimable
Janson 2004	1	0 (0)	1	0 (0)			Not estimable
Lacy 2002	1	0 (0)	1	0 (0)			Not estimable
Leung 2000	1	0 (0)	1	0 (0)			Not estimable
Leung 2004	1	0 (0)	1	0 (0)			Not estimable
Liang 2002	1	0 (0)	1	0 (0)			Not estimable
Milsom 1998	1	0 (0)	1	0 (0)			Not estimable
Milsom 2001	1	0 (0)	1	0 (0)			Not estimable
Ortiz 1996	1	0 (0)	1	0 (0)			Not estimable
Schwenk 2002	30	23.8 (7)	30	22.1 (5.5)		66.77%	1.7[-1.49,4.89]
Solomon 2002	1	0 (0)	1	0 (0)			Not estimable
Stage 1997	1	0 (0)	1	0 (0)			Not estimable
Tang 2001	1	0 (0)	1	0 (0)			Not estimable
Weeks 2002	1	0 (0)	1	0 (0)			Not estimable
Winslow 2002	37	34.8 (8.6)	46	36.1 (13.1)		30.79%	-1.3[-5.99,3.39]
Wu 2002	1	0 (0)	1	0 (0)			Not estimable
Total * **	**107**		**116**			**100%**	**0.76[-1.84,3.36]**



Favours laparoscopic — Favours conventional

Study or subgroup	Laparoscopic N	Laparoscopic Mean(SD)	Conventional N	Conventional Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
Heterogeneity: Tau²=0; Chi²=1.08, df=2(P=0.58); I²=0%							
Test for overall effect: Z=0.57(P=0.57)							

Favours laparoscopic -10 -5 0 5 10 Favours conventional

Comparison 3. Pain

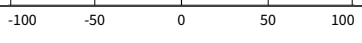
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Pain Perception	25	1705	Mean Difference (IV, Random, 95% CI)	-9.09 [-14.03, -4.14]
1.1 Pain Score 1st Postoperative Day	25	729	Mean Difference (IV, Random, 95% CI)	-9.30 [-13.19, -5.42]
1.2 Pain Score 2nd Postoperative Day	25	757	Mean Difference (IV, Random, 95% CI)	-7.85 [-18.87, 3.18]
1.3 Pain Score 3rd Postoperative Day	25	219	Mean Difference (IV, Random, 95% CI)	-12.88 [-19.74, -6.02]

Analysis 3.1. Comparison 3 Pain, Outcome 1 Pain Perception.

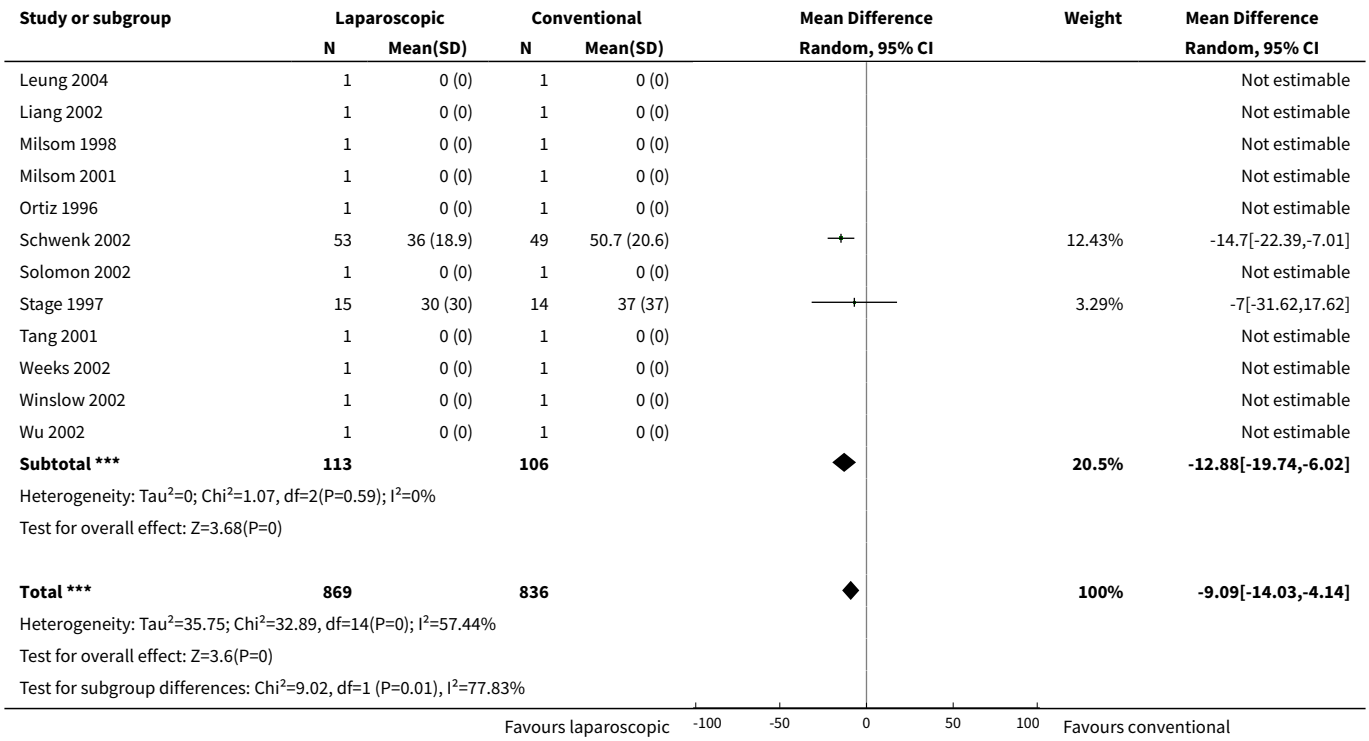
Study or subgroup	Laparoscopic N	Laparoscopic Mean(SD)	Conventional N	Conventional Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
3.1.1 Pain Score 1st Postoperative Day							
Braga 2002 a	40	55 (55)	39	60 (60)		3.12%	-5[-30.4,20.4]
Braga 2002 b	1	0 (0)	1	0 (0)			Not estimable
COST 2004	1	0 (0)	1	0 (0)			Not estimable
Curet 2000	1	0 (0)	1	0 (0)			Not estimable
Danelli 2002	23	40 (40)	21	50 (50)		2.83%	-10[-36.92,16.92]
Dunker 2002	1	0 (0)	1	0 (0)			Not estimable
Hasegawa 2003	1	0 (0)	1	0 (0)			Not estimable
Hewitt 1998	1	0 (0)	1	0 (0)			Not estimable
Hildebrandt 2003 a	1	0 (0)	1	0 (0)			Not estimable
Hildebrandt 2003 b	1	0 (0)	1	0 (0)			Not estimable
Janson 2004	1	0 (0)	1	0 (0)			Not estimable
Lacy 2002	1	0 (0)	1	0 (0)			Not estimable
Leung 2000	17	55 (55)	17	62.5 (62.5)		1.43%	-7.5[-47.08,32.08]
Leung 2004	203	46 (24)	200	54 (23)		15.42%	-8[-12.59,-3.41]
Liang 2002	1	0 (0)	1	0 (0)			Not estimable
Milsom 1998	1	0 (0)	1	0 (0)			Not estimable
Milsom 2001	1	0 (0)	1	0 (0)			Not estimable
Ortiz 1996	1	0 (0)	1	0 (0)			Not estimable
Schwenk 2002	53	47.8 (22.3)	49	61.6 (20.7)		11.8%	-13.8[-22.14,-5.46]
Solomon 2002	1	0 (0)	1	0 (0)			Not estimable
Stage 1997	15	38 (38)	14	52 (52)		1.96%	-14[-47.34,19.34]

Favours laparoscopic -100 -50 0 50 100 Favours conventional

Study or subgroup	Laparoscopic N	Laparoscopic Mean(SD)	Conventional N	Conventional Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
Tang 2001	1	0 (0)	1	0 (0)			Not estimable
Weeks 2002	1	0 (0)	1	0 (0)			Not estimable
Winslow 2002	1	0 (0)	1	0 (0)			Not estimable
Wu 2002	1	0 (0)	1	0 (0)			Not estimable
Subtotal * **	**370**		**359**			**36.58%**	**-9.3[-13.19,-5.42]**
Heterogeneity: Tau²=0; Chi²=1.62, df=5(P=0.9); I²=0%							
Test for overall effect: Z=4.7(P<0.0001)							
3.1.2 Pain Score 2nd Postoperative Day							
Braga 2002 a	40	40 (40)	39	40 (40)		5.45%	0[-17.64,17.64]
Braga 2002 b	1	0 (0)	1	0 (0)			Not estimable
COST 2004	1	0 (0)	1	0 (0)			Not estimable
Curet 2000	1	0 (0)	1	0 (0)			Not estimable
Danelli 2002	23	30 (30)	21	45 (45)		3.71%	-15[-37.82,7.82]
Dunker 2002	1	0 (0)	1	0 (0)			Not estimable
Hasegawa 2003	1	0 (0)	1	0 (0)			Not estimable
Hewitt 1998	8	27 (27)	8	62 (62)		1.05%	-35[-81.86,11.86]
Hildebrandt 2003 a	1	0 (0)	1	0 (0)			Not estimable
Hildebrandt 2003 b	1	0 (0)	1	0 (0)			Not estimable
Janson 2004	1	0 (0)	1	0 (0)			Not estimable
Lacy 2002	1	0 (0)	1	0 (0)			Not estimable
Leung 2000	1	0 (0)	1	0 (0)			Not estimable
Leung 2004	1	0 (0)	1	0 (0)			Not estimable
Liang 2002	1	0 (0)	1	0 (0)			Not estimable
Milsom 1998	1	0 (0)	1	0 (0)			Not estimable
Milsom 2001	1	0 (0)	1	0 (0)			Not estimable
Ortiz 1996	1	0 (0)	1	0 (0)			Not estimable
Schwenk 2002	53	44.8 (20.3)	49	64.6 (22.8)		11.75%	-19.8[-28.2,-11.4]
Solomon 2002	1	0 (0)	1	0 (0)			Not estimable
Stage 1997	15	28 (28)	14	25 (25)		4.79%	3[-16.29,22.29]
Tang 2001	1	0 (0)	1	0 (0)			Not estimable
Weeks 2002	228	20 (20)	221	20 (20)		16.18%	0[-3.7,3.7]
Winslow 2002	1	0 (0)	1	0 (0)			Not estimable
Wu 2002	1	0 (0)	1	0 (0)			Not estimable
Subtotal * **	**386**		**371**			**42.93%**	**-7.85[-18.87,3.18]**
Heterogeneity: Tau²=112.97; Chi²=21.18, df=5(P=0); I²=76.39%							
Test for overall effect: Z=1.39(P=0.16)							
3.1.3 Pain Score 3rd Postoperative Day							
Braga 2002 a	1	0 (0)	1	0 (0)			Not estimable
Braga 2002 b	1	0 (0)	1	0 (0)			Not estimable
COST 2004	1	0 (0)	1	0 (0)			Not estimable
Curet 2000	1	0 (0)	1	0 (0)			Not estimable
Danelli 2002	23	30 (30)	21	35 (35)		4.77%	-5[-24.35,14.35]
Dunker 2002	1	0 (0)	1	0 (0)			Not estimable
Hasegawa 2003	1	0 (0)	1	0 (0)			Not estimable
Hewitt 1998	1	0 (0)	1	0 (0)			Not estimable
Hildebrandt 2003 a	1	0 (0)	1	0 (0)			Not estimable
Hildebrandt 2003 b	1	0 (0)	1	0 (0)			Not estimable
Janson 2004	1	0 (0)	1	0 (0)			Not estimable
Lacy 2002	1	0 (0)	1	0 (0)			Not estimable
Leung 2000	1	0 (0)	1	0 (0)			Not estimable



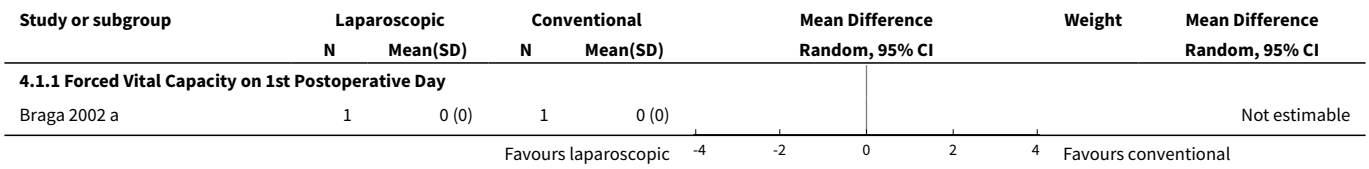
Favours laparoscopic — Favours conventional



Comparison 4. Pulmonary function

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 FVC day 1	25	608	Mean Difference (IV, Random, 95% CI)	0.27 [-0.03, 0.56]
1.1 Forced Vital Capacity on 1st Postoperative Day	25	177	Mean Difference (IV, Random, 95% CI)	0.38 [0.10, 0.66]
1.2 Forced Vital Capacity on 2nd Postoperative Day	25	254	Mean Difference (IV, Random, 95% CI)	0.05 [-0.62, 0.72]
1.3 Forced Vital Capacity on 3rd Postoperative Day	25	177	Mean Difference (IV, Random, 95% CI)	0.56 [0.21, 0.92]
7 Day of recovery of 80% FVC	25	215	Mean Difference (IV, Random, 95% CI)	-1.43 [-4.37, 1.51]

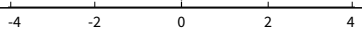
Analysis 4.1. Comparison 4 Pulmonary function, Outcome 1 FVC day 1.



Study or subgroup	Laparoscopic		Conventional		Mean Difference	Weight	Mean Difference
	N	Mean(SD)	N	Mean(SD)	Random, 95% CI		Random, 95% CI
Braga 2002 b	1	0 (0)	1	0 (0)			Not estimable
COST 2004	1	0 (0)	1	0 (0)			Not estimable
Curet 2000	1	0 (0)	1	0 (0)			Not estimable
Danelli 2002	1	0 (0)	1	0 (0)			Not estimable
Dunker 2002	1	0 (0)	1	0 (0)			Not estimable
Hasegawa 2003	1	0 (0)	1	0 (0)			Not estimable
Hewitt 1998	1	0 (0)	1	0 (0)			Not estimable
Hildebrandt 2003 a	1	0 (0)	1	0 (0)			Not estimable
Hildebrandt 2003 b	1	0 (0)	1	0 (0)			Not estimable
Janson 2004	1	0 (0)	1	0 (0)			Not estimable
Lacy 2002	1	0 (0)	1	0 (0)			Not estimable
Leung 2000	1	0 (0)	1	0 (0)			Not estimable
Leung 2004	1	0 (0)	1	0 (0)			Not estimable
Liang 2002	1	0 (0)	1	0 (0)			Not estimable
Milsom 1998	1	0 (0)	1	0 (0)			Not estimable
Milsom 2001	1	0 (0)	1	0 (0)			Not estimable
Ortiz 1996	1	0 (0)	1	0 (0)			Not estimable
Schwenk 2002	53	2.2 (0.8)	49	1.8 (0.7)		23.58%	0.4[0.11,0.69]
Solomon 2002	1	0 (0)	1	0 (0)			Not estimable
Stage 1997	15	1.5 (1.5)	14	1.4 (1.4)		6.14%	0.1[-0.96,1.16]
Tang 2001	1	0 (0)	1	0 (0)			Not estimable
Weeks 2002	1	0 (0)	1	0 (0)			Not estimable
Winslow 2002	1	0 (0)	1	0 (0)			Not estimable
Wu 2002	1	0 (0)	1	0 (0)			Not estimable
Subtotal * **	**91**		**86**			**29.72%**	**0.38[0.1,0.66]**
Heterogeneity: Tau²=0; Chi²=0.29, df=1(P=0.59); I²=0%							
Test for overall effect: Z=2.64(P=0.01)							
4.1.2 Forced Vital Capacity on 2nd Postoperative Day							
Braga 2002 a	40	1.9 (0.9)	39	2.3 (1.1)		17.84%	-0.36[-0.81,0.09]
Braga 2002 b	1	0 (0)	1	0 (0)			Not estimable
COST 2004	1	0 (0)	1	0 (0)			Not estimable
Curet 2000	1	0 (0)	1	0 (0)			Not estimable
Danelli 2002	1	0 (0)	1	0 (0)			Not estimable
Dunker 2002	1	0 (0)	1	0 (0)			Not estimable
Hasegawa 2003	1	0 (0)	1	0 (0)			Not estimable
Hewitt 1998	1	0 (0)	1	0 (0)			Not estimable
Hildebrandt 2003 a	1	0 (0)	1	0 (0)			Not estimable
Hildebrandt 2003 b	1	0 (0)	1	0 (0)			Not estimable
Janson 2004	1	0 (0)	1	0 (0)			Not estimable
Lacy 2002	1	0 (0)	1	0 (0)			Not estimable
Leung 2000	1	0 (0)	1	0 (0)			Not estimable
Leung 2004	1	0 (0)	1	0 (0)			Not estimable
Liang 2002	1	0 (0)	1	0 (0)			Not estimable
Milsom 1998	1	0 (0)	1	0 (0)			Not estimable
Milsom 2001	1	0 (0)	1	0 (0)			Not estimable
Ortiz 1996	1	0 (0)	1	0 (0)			Not estimable
Schwenk 2002	53	2.5 (1)	49	2 (0.7)		22.18%	0.5[0.17,0.83]
Solomon 2002	1	0 (0)	1	0 (0)			Not estimable
Stage 1997	15	1.5 (1.5)	14	1.6 (1.6)		5.49%	-0.1[-1.23,1.03]
Tang 2001	1	0 (0)	1	0 (0)			Not estimable
Weeks 2002	1	0 (0)	1	0 (0)			Not estimable

Favours laparoscopic — Favours conventional

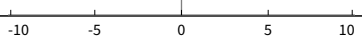
Study or subgroup	Laparoscopic N	Laparoscopic Mean(SD)	Conventional N	Conventional Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
Winslow 2002	1	0 (0)	1	0 (0)			Not estimable
Wu 2002	1	0 (0)	1	0 (0)			Not estimable
Subtotal ***	**130**		**124**			**45.51%**	**0.05[-0.62,0.72]**
Heterogeneity: Tau^2=0.25; Chi^2=9.45, df=2(P=0.01); I^2=78.84%							
Test for overall effect: Z=0.15(P=0.88)							
4.1.3 Forced Vital Capacity on 3rd Postoperative Day							
Braga 2002 a	1	0 (0)	1	0 (0)			Not estimable
Braga 2002 b	1	0 (0)	1	0 (0)			Not estimable
COST 2004	1	0 (0)	1	0 (0)			Not estimable
Curet 2000	1	0 (0)	1	0 (0)			Not estimable
Danelli 2002	1	0 (0)	1	0 (0)			Not estimable
Dunker 2002	1	0 (0)	1	0 (0)			Not estimable
Hasegawa 2003	1	0 (0)	1	0 (0)			Not estimable
Hewitt 1998	1	0 (0)	1	0 (0)			Not estimable
Hildebrandt 2003 a	1	0 (0)	1	0 (0)			Not estimable
Hildebrandt 2003 b	1	0 (0)	1	0 (0)			Not estimable
Janson 2004	1	0 (0)	1	0 (0)			Not estimable
Lacy 2002	1	0 (0)	1	0 (0)			Not estimable
Leung 2000	1	0 (0)	1	0 (0)			Not estimable
Leung 2004	1	0 (0)	1	0 (0)			Not estimable
Liang 2002	1	0 (0)	1	0 (0)			Not estimable
Milsom 1998	1	0 (0)	1	0 (0)			Not estimable
Milsom 2001	1	0 (0)	1	0 (0)			Not estimable
Ortiz 1996	1	0 (0)	1	0 (0)			Not estimable
Schwenk 2002	53	2.9 (1.1)	49	2.3 (0.8)		20.49%	0.61[0.24,0.98]
Solomon 2002	1	0 (0)	1	0 (0)			Not estimable
Stage 1997	15	1.8 (1.8)	14	1.8 (1.8)		4.28%	0[-1.31,1.31]
Tang 2001	1	0 (0)	1	0 (0)			Not estimable
Weeks 2002	1	0 (0)	1	0 (0)			Not estimable
Winslow 2002	1	0 (0)	1	0 (0)			Not estimable
Wu 2002	1	0 (0)	1	0 (0)			Not estimable
Subtotal ***	**91**		**86**			**24.77%**	**0.56[0.21,0.92]**
Heterogeneity: Tau^2=0; Chi^2=0.77, df=1(P=0.38); I^2=0%							
Test for overall effect: Z=3.08(P=0)							
Total ***	**312**		**296**			**100%**	**0.27[-0.03,0.56]**
Heterogeneity: Tau^2=0.07; Chi^2=13.47, df=6(P=0.04); I^2=55.46%							
Test for overall effect: Z=1.79(P=0.07)							
Test for subgroup differences: Chi^2=2.96, df=1 (P=0.23), I^2=32.47%							



Favours laparoscopic — Favours conventional

Analysis 4.7. Comparison 4 Pulmonary function, Outcome 7 Day of recovery of 80% FVC.

Study or subgroup	Laparoscopic N	Laparoscopic Mean(SD)	Conventional N	Conventional Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
Braga 2002 a	1	0 (0)	1	0 (0)			Not estimable
Braga 2002 b	1	0 (0)	1	0 (0)			Not estimable
COST 2004	1	0 (0)	1	0 (0)			Not estimable



Favours laparoscopic — Favours conventional

Study or subgroup	Laparoscopic N	Laparoscopic Mean(SD)	Conventional N	Conventional Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
Curet 2000	1	0 (0)	1	0 (0)			Not estimable
Danelli 2002	1	0 (0)	1	0 (0)			Not estimable
Dunker 2002	1	0 (0)	1	0 (0)			Not estimable
Hasegawa 2003	1	0 (0)	1	0 (0)			Not estimable
Hewitt 1998	1	0 (0)	1	0 (0)			Not estimable
Hildebrandt 2003 a	1	0 (0)	1	0 (0)			Not estimable
Hildebrandt 2003 b	1	0 (0)	1	0 (0)			Not estimable
Janson 2004	1	0 (0)	1	0 (0)			Not estimable
Lacy 2002	1	0 (0)	1	0 (0)			Not estimable
Leung 2000	1	0 (0)	1	0 (0)			Not estimable
Leung 2004	1	0 (0)	1	0 (0)			Not estimable
Liang 2002	1	0 (0)	1	0 (0)			Not estimable
Milsom 1998	55	3 (3)	54	6 (6)		47.7%	-3[-4.79,-1.21]
Milsom 2001	31	2.5 (2.5)	29	2.5 (2.5)		52.3%	0[-1.27,1.27]
Ortiz 1996	1	0 (0)	1	0 (0)			Not estimable
Schwenk 2002	1	0 (0)	1	0 (0)			Not estimable
Solomon 2002	1	0 (0)	1	0 (0)			Not estimable
Stage 1997	1	0 (0)	1	0 (0)			Not estimable
Tang 2001	1	0 (0)	1	0 (0)			Not estimable
Weeks 2002	1	0 (0)	1	0 (0)			Not estimable
Winslow 2002	1	0 (0)	1	0 (0)			Not estimable
Wu 2002	1	0 (0)	1	0 (0)			Not estimable
Total ***	**109**		**106**			**100%**	**-1.43[-4.37,1.51]**

Heterogeneity: Tau^2=3.88; Chi^2=7.21, df=1(P=0.01); I^2=86.14%

Test for overall effect: Z=0.96(P=0.34)

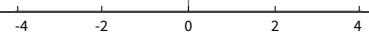
Comparison 5. Ileus

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Duration of Postoperative Ileus	25	2312	Mean Difference (IV, Random, 95% CI)	-1.02 [-1.18, -0.87]
1.1 Duration from Surgery to First Flatus	25	1150	Mean Difference (IV, Random, 95% CI)	-1.03 [-1.30, -0.76]
1.2 Duration from Surgery to First Bowel Movement	25	1162	Mean Difference (IV, Random, 95% CI)	-0.93 [-1.13, -0.74]

Analysis 5.1. Comparison 5 Ileus, Outcome 1 Duration of Postoperative Ileus.

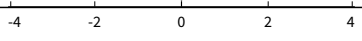
Study or subgroup	Laparoscopic N	Laparoscopic Mean(SD)	Conventional N	Conventional Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
5.1.1 Duration from Surgery to First Flatus							

Study or subgroup	Laparoscopic N	Laparoscopic Mean(SD)	Conventional N	Conventional Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
Braga 2002 a	40	2 (2)	39	2 (2)		2.82%	0[-0.88,0.88]
Braga 2002 b	136	2.1 (0.2)	133	3.3 (0.6)		34.42%	-1.2[-1.31,-1.09]
COST 2004	1	0 (0)	1	0 (0)			Not estimable
Curet 2000	1	0 (0)	1	0 (0)			Not estimable
Danelli 2002	23	1 (1)	21	2.9 (2.9)		1.33%	-1.9[-3.21,-0.59]
Dunker 2002	1	0 (0)	1	0 (0)			Not estimable
Hasegawa 2003	24	2 (2)	26	3.3 (3.3)		1.02%	-1.3[-2.8,0.2]
Hewitt 1998	1	0 (0)	1	0 (0)			Not estimable
Hildebrandt 2003 a	1	0 (0)	1	0 (0)			Not estimable
Hildebrandt 2003 b	1	0 (0)	1	0 (0)			Not estimable
Janson 2004	1	0 (0)	1	0 (0)			Not estimable
Lacy 2002	1	0 (0)	1	0 (0)			Not estimable
Leung 2000	1	0 (0)	1	0 (0)			Not estimable
Leung 2004	203	2.4 (2.4)	200	3.1 (3.1)		6.71%	-0.7[-1.24,-0.16]
Liang 2002	1	0 (0)	1	0 (0)			Not estimable
Milsom 1998	55	3 (3)	54	4 (4)		1.29%	-1[-2.33,0.33]
Milsom 2001	31	3 (3)	29	3.3 (3.3)		0.9%	-0.3[-1.9,1.3]
Ortiz 1996	1	0 (0)	1	0 (0)			Not estimable
Schwenk 2002	53	2.1 (0.8)	49	3.3 (0.9)		14.9%	-1.2[-1.52,-0.88]
Solomon 2002	1	0 (0)	1	0 (0)			Not estimable
Stage 1997	1	0 (0)	1	0 (0)			Not estimable
Tang 2001	1	0 (0)	1	0 (0)			Not estimable
Weeks 2002	1	0 (0)	1	0 (0)			Not estimable
Winslow 2002	1	0 (0)	1	0 (0)			Not estimable
Wu 2002	1	0 (0)	1	0 (0)			Not estimable
Subtotal * **	**582**		**568**			**63.39%**	**-1.03[-1.3,-0.76]**
Heterogeneity: Tau^2=0.05; Chi^2=12.41, df=7(P=0.09); I^2=43.6%							
Test for overall effect: Z=7.44(P<0.0001)							
5.1.2 Duration from Surgery to First Bowel Movement							
Braga 2002 a	40	5 (5)	39	6 (6)		0.39%	-1[-3.44,1.44]
Braga 2002 b	136	4.7 (0.8)	133	5.7 (1.1)		21.41%	-1[-1.23,-0.77]
COST 2004	1	0 (0)	1	0 (0)			Not estimable
Curet 2000	1	0 (0)	1	0 (0)			Not estimable
Danelli 2002	23	3 (3)	21	4 (4)		0.52%	-1[-3.1,1.1]
Dunker 2002	1	0 (0)	1	0 (0)			Not estimable
Hasegawa 2003	1	0 (0)	1	0 (0)			Not estimable
Hewitt 1998	1	0 (0)	1	0 (0)			Not estimable
Hildebrandt 2003 a	1	0 (0)	1	0 (0)			Not estimable
Hildebrandt 2003 b	1	0 (0)	1	0 (0)			Not estimable
Janson 2004	1	0 (0)	1	0 (0)			Not estimable
Lacy 2002	1	0 (0)	1	0 (0)			Not estimable
Leung 2000	17	3 (3)	17	3 (3)		0.57%	0[-2.02,2.02]
Leung 2004	203	4 (4)	200	4.6 (4.6)		3.07%	-0.6[-1.44,0.24]
Liang 2002	1	0 (0)	1	0 (0)			Not estimable
Milsom 1998	55	4.8 (4.8)	54	4.8 (4.8)		0.71%	0[-1.8,1.8]
Milsom 2001	31	5 (5)	29	6 (6)		0.3%	-1[-3.8,1.8]
Ortiz 1996	15	5.4 (5.4)	15	5.5 (5.5)		0.15%	-0.1[-4,3.8]
Schwenk 2002	53	2.9 (1.3)	49	3.8 (0.9)		9.48%	-0.89[-1.33,-0.45]
Solomon 2002	1	0 (0)	1	0 (0)			Not estimable
Stage 1997	1	0 (0)	1	0 (0)			Not estimable
Tang 2001	1	0 (0)	1	0 (0)			Not estimable



Favours laparoscopic Favours conventional

Study or subgroup	Laparoscopic N	Laparoscopic Mean(SD)	Conventional N	Conventional Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
Weeks 2002	1	0 (0)	1	0 (0)			Not estimable
Winslow 2002	1	0 (0)	1	0 (0)			Not estimable
Wu 2002	1	0 (0)	1	0 (0)			Not estimable
Subtotal ***	**589**		**573**			**36.61%**	**-0.93[-1.13,-0.74]**
Heterogeneity: Tau^2=0; Chi^2=3, df=8(P=0.93); I^2=0%							
Test for overall effect: Z=9.45(P<0.0001)							
Total ***	**1171**		**1141**			**100%**	**-1.02[-1.18,-0.87]**
Heterogeneity: Tau^2=0.01; Chi^2=19.87, df=16(P=0.23); I^2=19.49%							
Test for overall effect: Z=13.07(P<0.0001)							
Test for subgroup differences: Chi^2=4.47, df=1 (P=0.03), I^2=77.6%							



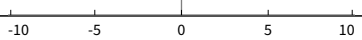
Favours laparoscopic — Favours conventional

Comparison 6. Hospital stay

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Postoperative hospital stay	25	3009	Mean Difference (IV, Random, 95% CI)	-1.44 [-1.83, -1.06]

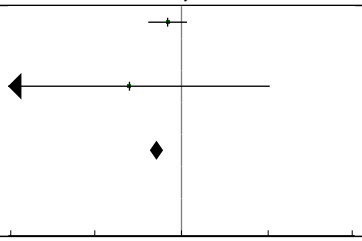
Analysis 6.1. Comparison 6 Hospital stay, Outcome 1 Postoperative hospital stay.

Study or subgroup	Laparoscopic N	Laparoscopic Mean(SD)	Conventinal N	Conventinal Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
Braga 2002 a	40	9.1 (2.9)	39	11.7 (5.1)		4.34%	-2.6[-4.44,-0.76]
Braga 2002 b	136	10.4 (2.9)	133	12.5 (4.1)		20.22%	-2.1[-2.95,-1.25]
COST 2004	435	5 (5)	428	6 (6)		26.89%	-1[-1.74,-0.26]
Curet 2000	18	5.2 (5.2)	18	7.3 (7.3)		0.85%	-2.1[-6.24,2.04]
Danelli 2002	1	0 (0)	1	0 (0)			Not estimable
Dunker 2002	1	0 (0)	1	0 (0)			Not estimable
Hasegawa 2003	24	7.1 (7.1)	26	12.7 (12.7)		0.46%	-5.6[-11.25,0.05]
Hewitt 1998	8	6 (6)	8	7 (7)		0.36%	-1[-7.39,5.39]
Hildebrandt 2003 a	1	0 (0)	1	0 (0)			Not estimable
Hildebrandt 2003 b	1	0 (0)	1	0 (0)			Not estimable
Janson 2004	98	9 (9)	112	9.1 (9.1)		2.43%	-0.1[-2.55,2.35]
Lacy 2002	111	5.2 (2.1)	108	7.9 (9.3)		4.53%	-2.7[-4.5,-0.9]
Leung 2000	17	6 (6)	17	7 (7)		0.76%	-1[-5.38,3.38]
Leung 2004	203	8.2 (8.2)	200	8.7 (8.7)		5.36%	-0.5[-2.15,1.15]
Liang 2002	1	0 (0)	1	0 (0)			Not estimable
Milsom 1998	55	6 (6)	54	7 (7)		2.44%	-1[-3.45,1.45]
Milsom 2001	31	5 (5)	29	6 (6)		1.86%	-1[-3.8,1.8]
Ortiz 1996	1	0 (0)	1	0 (0)			Not estimable
Schwenk 2002	53	9.1 (2.9)	49	10.6 (2)		15.63%	-1.5[-2.47,-0.53]
Solomon 2002	20	3.9 (3.9)	19	6.6 (6.6)		1.25%	-2.7[-6.12,0.72]
Stage 1997	15	5 (5)	14	8 (8)		0.61%	-3[-7.9,1.9]
Tang 2001	1	0 (0)	1	0 (0)			Not estimable



Favours laparoscopic — Favours conventional

Study or subgroup	Laparoscopic N	Laparoscopic Mean(SD)	Conventinal N	Conventinal Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
Weeks 2002	228	5.6 (5.6)	221	6.4 (6.4)		11.79%	-0.8[-1.91,0.31]
Winslow 2002	1	0 (0)	1	0 (0)			Not estimable
Wu 2002	12	9 (9)	14	12 (12)		0.22%	-3[-11.09,5.09]
Total ***	**1512**		**1497**			**100%**	**-1.44[-1.83,-1.06]**
Heterogeneity: Tau^2=0; Chi^2=14.29, df=16(P=0.58); I^2=0%							
Test for overall effect: Z=7.4(P<0.0001)							



Favours laparoscopic — Favours conventional

Comparison 7. Quality of life

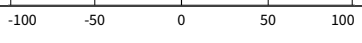
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 QLQ-Scores	25	771	Mean Difference (IV, Random, 95% CI)	7.22 [0.18, 14.27]
1.1 QLQ-Scores on 7th Postoperative Day	25	108	Mean Difference (IV, Random, 95% CI)	10.5 [-0.26, 21.26]
1.2 QLQ-Scores on 30th Postoperative Day	25	108	Mean Difference (IV, Random, 95% CI)	14.80 [3.05, 26.55]
1.3 QLQ-Scores on 60th Postoperative Day	25	555	Mean Difference (IV, Random, 95% CI)	0.48 [-8.73, 9.69]

Analysis 7.1. Comparison 7 Quality of life, Outcome 1 QLQ-Scores.

Study or subgroup	Laparoscopic N	Laparoscopic Mean(SD)	Conventional N	Conventional Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
7.1.1 QLQ-Scores on 7th Postoperative Day							
Braga 2002 a	1	0 (0)	1	0 (0)			Not estimable
Braga 2002 b	1	0 (0)	1	0 (0)			Not estimable
COST 2004	1	0 (0)	1	0 (0)			Not estimable
Curet 2000	1	0 (0)	1	0 (0)			Not estimable
Danelli 2002	1	0 (0)	1	0 (0)			Not estimable
Dunker 2002	1	0 (0)	1	0 (0)			Not estimable
Hasegawa 2003	1	0 (0)	1	0 (0)			Not estimable
Hewitt 1998	1	0 (0)	1	0 (0)			Not estimable
Hildebrandt 2003 a	1	0 (0)	1	0 (0)			Not estimable
Hildebrandt 2003 b	1	0 (0)	1	0 (0)			Not estimable
Janson 2004	1	0 (0)	1	0 (0)			Not estimable
Lacy 2002	1	0 (0)	1	0 (0)			Not estimable
Leung 2000	1	0 (0)	1	0 (0)			Not estimable
Leung 2004	1	0 (0)	1	0 (0)			Not estimable
Liang 2002	1	0 (0)	1	0 (0)			Not estimable
Milsom 1998	1	0 (0)	1	0 (0)			Not estimable

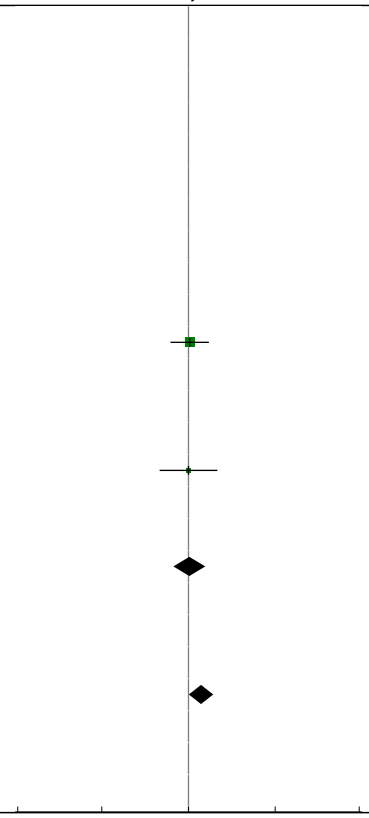
Favours laparoscopic — Favours conventional

Study or subgroup	Laparoscopic		Conventional		Mean Difference	Weight	Mean Difference
	N	Mean(SD)	N	Mean(SD)	Random, 95% CI		Random, 95% CI
Milsom 2001	1	0 (0)	1	0 (0)			Not estimable
Ortiz 1996	1	0 (0)	1	0 (0)			Not estimable
Schwenk 2002	30	58.3 (22.7)	30	47.8 (19.7)		29.84%	10.5[-0.26,21.26]
Solomon 2002	1	0 (0)	1	0 (0)			Not estimable
Stage 1997	1	0 (0)	1	0 (0)			Not estimable
Tang 2001	1	0 (0)	1	0 (0)			Not estimable
Weeks 2002	1	0 (0)	1	0 (0)			Not estimable
Winslow 2002	1	0 (0)	1	0 (0)			Not estimable
Wu 2002	1	0 (0)	1	0 (0)			Not estimable
Subtotal ***	**54**		**54**			**29.84%**	**10.5[-0.26,21.26]**
Heterogeneity: Not applicable							
Test for overall effect: Z=1.91(P=0.06)							
7.1.2 QLQ-Scores on 30th Postoperative Day							
Braga 2002 a	1	0 (0)	1	0 (0)			Not estimable
Braga 2002 b	1	0 (0)	1	0 (0)			Not estimable
COST 2004	1	0 (0)	1	0 (0)			Not estimable
Curet 2000	1	0 (0)	1	0 (0)			Not estimable
Danelli 2002	1	0 (0)	1	0 (0)			Not estimable
Dunker 2002	1	0 (0)	1	0 (0)			Not estimable
Hasegawa 2003	1	0 (0)	1	0 (0)			Not estimable
Hewitt 1998	1	0 (0)	1	0 (0)			Not estimable
Hildebrandt 2003 a	1	0 (0)	1	0 (0)			Not estimable
Hildebrandt 2003 b	1	0 (0)	1	0 (0)			Not estimable
Janson 2004	1	0 (0)	1	0 (0)			Not estimable
Lacy 2002	1	0 (0)	1	0 (0)			Not estimable
Leung 2000	1	0 (0)	1	0 (0)			Not estimable
Leung 2004	1	0 (0)	1	0 (0)			Not estimable
Liang 2002	1	0 (0)	1	0 (0)			Not estimable
Milsom 1998	1	0 (0)	1	0 (0)			Not estimable
Milsom 2001	1	0 (0)	1	0 (0)			Not estimable
Ortiz 1996	1	0 (0)	1	0 (0)			Not estimable
Schwenk 2002	30	70.8 (22.5)	30	56 (23.9)		26.31%	14.8[3.05,26.55]
Solomon 2002	1	0 (0)	1	0 (0)			Not estimable
Stage 1997	1	0 (0)	1	0 (0)			Not estimable
Tang 2001	1	0 (0)	1	0 (0)			Not estimable
Weeks 2002	1	0 (0)	1	0 (0)			Not estimable
Winslow 2002	1	0 (0)	1	0 (0)			Not estimable
Wu 2002	1	0 (0)	1	0 (0)			Not estimable
Subtotal ***	**54**		**54**			**26.31%**	**14.8[3.05,26.55]**
Heterogeneity: Not applicable							
Test for overall effect: Z=2.47(P=0.01)							
7.1.3 QLQ-Scores on 60th Postoperative Day							
Braga 2002 a	1	0 (0)	1	0 (0)			Not estimable
Braga 2002 b	1	0 (0)	1	0 (0)			Not estimable
COST 2004	1	0 (0)	1	0 (0)			Not estimable
Curet 2000	1	0 (0)	1	0 (0)			Not estimable
Danelli 2002	1	0 (0)	1	0 (0)			Not estimable
Dunker 2002	1	0 (0)	1	0 (0)			Not estimable
Hasegawa 2003	1	0 (0)	1	0 (0)			Not estimable
Hewitt 1998	1	0 (0)	1	0 (0)			Not estimable



Favours laparoscopic — Favours conventional

Study or subgroup	Laparoscopic		Conventional		Mean Difference	Weight	Mean Difference
	N	Mean(SD)	N	Mean(SD)	Random, 95% CI		Random, 95% CI
Hildebrandt 2003 a	1	0 (0)	1	0 (0)			Not estimable
Hildebrandt 2003 b	1	0 (0)	1	0 (0)			Not estimable
Janson 2004	1	0 (0)	1	0 (0)			Not estimable
Lacy 2002	1	0 (0)	1	0 (0)			Not estimable
Leung 2000	1	0 (0)	1	0 (0)			Not estimable
Leung 2004	1	0 (0)	1	0 (0)			Not estimable
Liang 2002	1	0 (0)	1	0 (0)			Not estimable
Milsom 1998	1	0 (0)	1	0 (0)			Not estimable
Milsom 2001	1	0 (0)	1	0 (0)			Not estimable
Ortiz 1996	1	0 (0)	1	0 (0)			Not estimable
Schwenk 2002	30	68.8 (25.3)	30	68.1 (17.7)		28.73%	0.69[-10.36,11.74]
Solomon 2002	1	0 (0)	1	0 (0)			Not estimable
Stage 1997	1	0 (0)	1	0 (0)			Not estimable
Tang 2001	1	0 (0)	1	0 (0)			Not estimable
Weeks 2002	228	90 (90)	221	90 (90)		15.12%	0[-16.65,16.65]
Winslow 2002	1	0 (0)	1	0 (0)			Not estimable
Wu 2002	1	0 (0)	1	0 (0)			Not estimable
Subtotal * **	**281**		**274**			**43.86%**	**0.48[-8.73,9.69]**
Heterogeneity: Tau^2=0; Chi^2=0, df=1(P=0.95); I^2=0%							
Test for overall effect: Z=0.1(P=0.92)							
Total * **	**389**		**382**			**100%**	**7.22[0.18,14.27]**
Heterogeneity: Tau^2=13.13; Chi^2=4.02, df=3(P=0.26); I^2=25.36%							
Test for overall effect: Z=2.01(P=0.04)							
Test for subgroup differences: Chi^2=4.01, df=1 (P=0.13), I^2=50.18%							

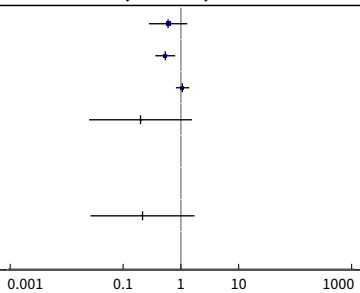


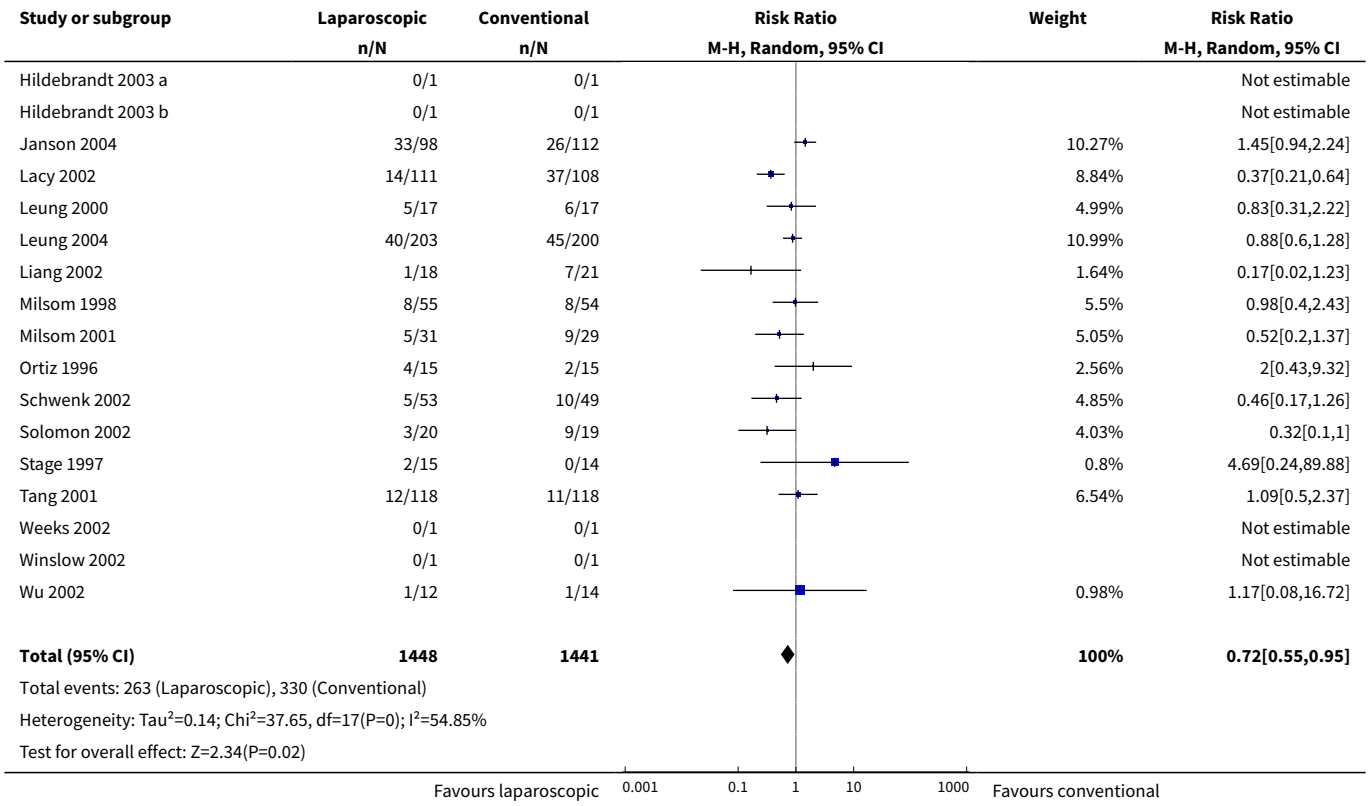
Comparison 8. Morbidity

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Total Morbidity (General and Local)	25	2889	Risk Ratio (M-H, Random, 95% CI)	0.72 [0.55, 0.95]

Analysis 8.1. Comparison 8 Morbidity, Outcome 1 Total Morbidity (General and Local).

Study or subgroup	Laparoscopic	Conventional	Risk Ratio	Weight	Risk Ratio
	n/N	n/N	M-H, Random, 95% CI		M-H, Random, 95% CI
Braga 2002 a	8/40	13/39		6.68%	0.6[0.28,1.29]
Braga 2002 b	28/136	51/133		10.8%	0.54[0.36,0.8]
COST 2004	92/435	85/428		12.35%	1.06[0.82,1.39]
Curet 2000	1/18	5/18		1.58%	0.2[0.03,1.55]
Danelli 2002	0/1	0/1			Not estimable
Dunker 2002	0/16	0/14			Not estimable
Hasegawa 2003	1/24	5/26		1.54%	0.22[0.03,1.72]
Hewitt 1998	0/8	0/8			Not estimable



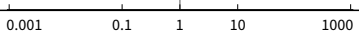


Comparison 9. Local (Surgical) Morbidity

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Local Morbidity (Total)	25	1706	Risk Ratio (M-H, Random, 95% CI)	0.55 [0.39, 0.77]
2 Wound Infection	25	1787	Risk Ratio (M-H, Random, 95% CI)	0.56 [0.39, 0.81]
3 Intraabdominal Abscess	25	1706	Risk Ratio (M-H, Random, 95% CI)	0.72 [0.29, 1.77]
4 Anastomotic Insufficiency	25	1783	Risk Ratio (M-H, Random, 95% CI)	0.63 [0.32, 1.24]
5 Postoperative Ileus	25	1790	Risk Ratio (M-H, Random, 95% CI)	0.42 [0.24, 0.75]
6 Postoperative bleeding	25	1706	Risk Ratio (M-H, Random, 95% CI)	0.45 [0.11, 1.81]
7 Fascial disrupture	25	1706	Risk Ratio (M-H, Random, 95% CI)	0.24 [0.03, 2.17]
8 Reoperation for Complication	25	1344	Risk Ratio (M-H, Random, 95% CI)	1.11 [0.67, 1.84]

Analysis 9.1. Comparison 9 Local (Surgical) Morbidity, Outcome 1 Local Morbidity (Total).

Study or subgroup	Laparoscopic n/N	Conventional n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
Braga 2002 a	0/1	0/1			Not estimable
Braga 2002 b	18/136	39/133		22.86%	0.45[0.27,0.75]
COST 2004	0/1	0/1			Not estimable
Curet 2000	1/18	2/18		2%	0.5[0.05,5.04]
Danelli 2002	0/1	0/1			Not estimable
Dunker 2002	0/16	0/14			Not estimable
Hasegawa 2003	1/24	5/26		2.45%	0.22[0.03,1.72]
Hewitt 1998	0/8	0/8			Not estimable
Hildebrandt 2003 a	0/1	0/1			Not estimable
Hildebrandt 2003 b	0/1	0/1			Not estimable
Janson 2004	0/1	0/1			Not estimable
Lacy 2002	11/111	34/108		17.83%	0.31[0.17,0.59]
Leung 2000	3/17	2/17		3.73%	1.5[0.29,7.87]
Leung 2004	20/203	32/200		21.99%	0.62[0.36,1.04]
Liang 2002	0/18	4/21		1.33%	0.13[0.01,2.24]
Milsom 1998	1/55	0/54		1.08%	2.95[0.12,70.77]
Milsom 2001	5/31	8/29		9.09%	0.58[0.22,1.58]
Ortiz 1996	4/15	2/15		4.28%	2[0.43,9.32]
Schwenk 2002	2/53	7/49		4.36%	0.26[0.06,1.21]
Solomon 2002	0/1	0/1			Not estimable
Stage 1997	0/15	0/14			Not estimable
Tang 2001	7/118	5/118		7.5%	1.4[0.46,4.29]
Weeks 2002	0/1	0/1			Not estimable
Winslow 2002	0/1	0/1			Not estimable
Wu 2002	1/12	1/14		1.52%	1.17[0.08,16.72]
Total (95% CI)	**859**	**847**		**100%**	**0.55[0.39,0.77]**
Total events: 74 (Laparoscopic), 141 (Conventional)					
Heterogeneity: Tau^2=0.06; Chi^2=14.61, df=12(P=0.26); I^2=17.85%					
Test for overall effect: Z=3.5(P=0)					



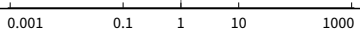
Favours laparoscopic — Favours conventional

Analysis 9.2. Comparison 9 Local (Surgical) Morbidity, Outcome 2 Wound Infection.

Study or subgroup	Laparoscopic n/N	Conventional n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
Braga 2002 a	0/1	0/1			Not estimable
Braga 2002 b	8/136	20/133		22.15%	0.39[0.18,0.86]
COST 2004	0/1	0/1			Not estimable
Curet 2000	1/18	1/18		1.88%	1[0.07,14.79]
Danelli 2002	0/1	0/1			Not estimable
Dunker 2002	0/16	0/14			Not estimable
Hasegawa 2003	1/24	3/26		2.83%	0.36[0.04,3.24]
Hewitt 1998	0/8	0/8			Not estimable
Hildebrandt 2003 a	0/1	0/1			Not estimable
Hildebrandt 2003 b	0/1	0/1			Not estimable
Janson 2004	0/1	0/1			Not estimable
Lacy 2002	8/111	18/108		21.85%	0.43[0.2,0.95]

Favours laparoscopic — Favours conventional

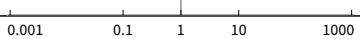
Study or subgroup	Laparoscopic n/N	Conventional n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
Leung 2000	0/17	1/17		1.39%	0.33[0.01,7.65]
Leung 2004	9/203	15/200		21.13%	0.59[0.26,1.32]
Liang 2002	0/18	2/21		1.54%	0.23[0.01,4.53]
Milsom 1998	0/55	0/54			Not estimable
Milsom 2001	2/31	3/29		4.63%	0.62[0.11,3.47]
Ortiz 1996	2/15	1/15		2.59%	2[0.2,19.78]
Schwenk 2002	1/53	5/49		3.06%	0.18[0.02,1.53]
Solomon 2002	0/1	0/1			Not estimable
Stage 1997	0/15	0/14			Not estimable
Tang 2001	3/118	3/118		5.46%	1[0.21,4.85]
Weeks 2002	0/1	0/1			Not estimable
Winslow 2002	5/37	5/46		10.1%	1.24[0.39,3.97]
Wu 2002	1/12	0/14		1.41%	3.46[0.15,77.86]
Total (95% CI)	**895**	**892**		**100%**	**0.56[0.39,0.81]**
Total events: 41 (Laparoscopic), 77 (Conventional)					
Heterogeneity: Tau^2=0; Chi^2=7.92, df=12(P=0.79); I^2=0%					
Test for overall effect: Z=3.11(P=0)					



Favours laparoscopic — Favours conventional

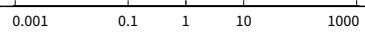
Analysis 9.3. Comparison 9 Local (Surgical) Morbidity, Outcome 3 Intraabdominal Abscess.

Study or subgroup	Laparoscopic n/N	Conventional n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
Braga 2002 a	0/1	0/1			Not estimable
Braga 2002 b	4/136	7/133		55.55%	0.56[0.17,1.86]
COST 2004	0/1	0/1			Not estimable
Curet 2000	0/18	0/18			Not estimable
Danelli 2002	0/1	0/1			Not estimable
Dunker 2002	0/16	0/14			Not estimable
Hasegawa 2003	0/24	0/26			Not estimable
Hewitt 1998	0/8	0/8			Not estimable
Hildebrandt 2003 a	0/1	0/1			Not estimable
Hildebrandt 2003 b	0/1	0/1			Not estimable
Janson 2004	0/1	0/1			Not estimable
Lacy 2002	0/111	0/108			Not estimable
Leung 2000	1/17	0/17		8.22%	3[0.13,68.84]
Leung 2004	1/203	2/200		14.09%	0.49[0.05,5.39]
Liang 2002	0/18	0/21			Not estimable
Milsom 1998	0/55	0/54			Not estimable
Milsom 2001	0/31	0/29			Not estimable
Ortiz 1996	0/15	0/15			Not estimable
Schwenk 2002	0/53	1/49		7.99%	0.31[0.01,7.4]
Solomon 2002	0/1	0/1			Not estimable
Stage 1997	0/15	0/14			Not estimable
Tang 2001	2/118	1/118		14.16%	2[0.18,21.76]
Weeks 2002	0/1	0/1			Not estimable
Winslow 2002	0/1	0/1			Not estimable
Wu 2002	0/12	0/14			Not estimable



Favours laparoscopic — Favours conventional

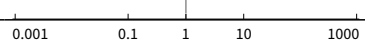
Study or subgroup	Laparoscopic n/N	Conventional n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
Total (95% CI)	**859**	**847**		**100%**	**0.72[0.29,1.77]**
Total events: 8 (Laparoscopic), 11 (Conventional)					
Heterogeneity: Tau^2=0; Chi^2=2.04, df=4(P=0.73); I^2=0%					
Test for overall effect: Z=0.72(P=0.47)					



Favours laparoscopic — Favours conventional

Analysis 9.4. Comparison 9 Local (Surgical) Morbidity, Outcome 4 Anastomotic Insufficiency.

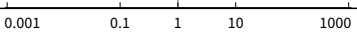
Study or subgroup	Laparoscopic n/N	Conventional n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
Braga 2002 a	1/40	3/39		9.25%	0.33[0.04,2.99]
Braga 2002 b	8/136	11/133		59.02%	0.71[0.3,1.71]
COST 2004	0/1	0/1			Not estimable
Curet 2000	0/18	0/18			Not estimable
Danelli 2002	0/1	0/1			Not estimable
Dunker 2002	0/16	0/14			Not estimable
Hasegawa 2003	0/24	0/26			Not estimable
Hewitt 1998	0/8	0/8			Not estimable
Hildebrandt 2003 a	0/1	0/1			Not estimable
Hildebrandt 2003 b	0/1	0/1			Not estimable
Janson 2004	0/1	0/1			Not estimable
Lacy 2002	0/111	2/108		4.98%	0.19[0.01,4.01]
Leung 2000	0/17	0/17			Not estimable
Leung 2004	1/203	4/200		9.57%	0.25[0.03,2.18]
Liang 2002	0/18	1/21		4.62%	0.39[0.02,8.93]
Milsom 1998	0/55	0/54			Not estimable
Milsom 2001	1/31	0/29		4.56%	2.81[0.12,66.4]
Ortiz 1996	0/15	0/15			Not estimable
Schwenk 2002	0/53	0/49			Not estimable
Solomon 2002	0/1	0/1			Not estimable
Stage 1997	0/15	0/14			Not estimable
Tang 2001	2/118	1/118		8%	2[0.18,21.76]
Weeks 2002	0/1	0/1			Not estimable
Winslow 2002	0/1	0/1			Not estimable
Wu 2002	0/12	0/14			Not estimable
Total (95% CI)	**898**	**885**		**100%**	**0.63[0.32,1.24]**
Total events: 13 (Laparoscopic), 22 (Conventional)					
Heterogeneity: Tau^2=0; Chi^2=3.57, df=6(P=0.73); I^2=0%					
Test for overall effect: Z=1.34(P=0.18)					



Favours laparoscopic — Favours conventional

Analysis 9.5. Comparison 9 Local (Surgical) Morbidity, Outcome 5 Postoperative Ileus.

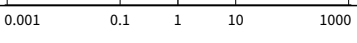
Study or subgroup	Laparoscopic n/N	Conventional n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
Braga 2002 a	0/1	0/1			Not estimable
Braga 2002 b	3/136	6/133		18.11%	0.49[0.12,1.91]
COST 2004	0/1	0/1			Not estimable
Curet 2000	0/18	1/18		3.43%	0.33[0.01,7.68]
Danelli 2002	0/1	0/1			Not estimable
Dunker 2002	0/16	0/14			Not estimable
Hasegawa 2003	0/24	2/26		3.78%	0.22[0.01,4.28]
Hewitt 1998	0/8	0/8			Not estimable
Hildebrandt 2003 a	0/1	0/1			Not estimable
Hildebrandt 2003 b	0/1	0/1			Not estimable
Janson 2004	0/1	0/1			Not estimable
Lacy 2002	3/111	8/108		19.96%	0.36[0.1,1.34]
Leung 2000	0/17	0/17			Not estimable
Leung 2004	4/203	6/203		21.59%	0.67[0.19,2.33]
Liang 2002	0/18	0/21			Not estimable
Milsom 1998	0/55	0/54			Not estimable
Milsom 2001	2/31	4/29		12.86%	0.47[0.09,2.36]
Ortiz 1996	1/15	0/15		3.46%	3[0.13,68.26]
Schwenk 2002	0/53	0/49			Not estimable
Solomon 2002	0/1	0/1			Not estimable
Stage 1997	0/15	0/14			Not estimable
Tang 2001	0/118	0/118			Not estimable
Weeks 2002	0/1	0/1			Not estimable
Winslow 2002	2/37	14/46		16.81%	0.18[0.04,0.73]
Wu 2002	0/12	0/14			Not estimable
Total (95% CI)	**895**	**895**		**100%**	**0.42[0.24,0.75]**
Total events: 15 (Laparoscopic), 41 (Conventional)					
Heterogeneity: Tau^2=0; Chi^2=3.81, df=7(P=0.8); I^2=0%					
Test for overall effect: Z=2.92(P=0)					



Favours laparoscopic — Favours conventional

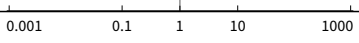
Analysis 9.6. Comparison 9 Local (Surgical) Morbidity, Outcome 6 Postoperative bleeding.

Study or subgroup	Laparoscopic n/N	Conventional n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
Braga 2002 a	0/1	0/1			Not estimable
Braga 2002 b	1/136	2/133		33.67%	0.49[0.04,5.33]
COST 2004	0/1	0/1			Not estimable
Curet 2000	0/18	0/18			Not estimable
Danelli 2002	0/1	0/1			Not estimable
Dunker 2002	0/16	0/14			Not estimable
Hasegawa 2003	0/24	0/26			Not estimable
Hewitt 1998	0/8	0/8			Not estimable
Hildebrandt 2003 a	0/1	0/1			Not estimable
Hildebrandt 2003 b	0/1	0/1			Not estimable
Janson 2004	0/1	0/1			Not estimable
Lacy 2002	0/111	2/108		21%	0.19[0.01,4.01]



Favours laparoscopic — Favours conventional

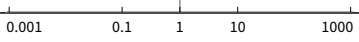
Study or subgroup	Laparoscopic n/N	Conventional n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
Leung 2000	0/17	0/17			Not estimable
Leung 2004	0/203	0/200			Not estimable
Liang 2002	0/18	0/21			Not estimable
Milsom 1998	0/55	0/54			Not estimable
Milsom 2001	0/31	0/29			Not estimable
Ortiz 1996	0/15	0/15			Not estimable
Schwenk 2002	1/53	1/49		25.51%	0.92[0.06,14.38]
Solomon 2002	0/1	0/1			Not estimable
Stage 1997	0/15	0/14			Not estimable
Tang 2001	0/118	0/118			Not estimable
Weeks 2002	0/1	0/1			Not estimable
Winslow 2002	0/1	0/1			Not estimable
Wu 2002	0/12	1/14		19.82%	0.38[0.02,8.65]
Total (95% CI)	**859**	**847**		**100%**	**0.45[0.11,1.81]**
Total events: 2 (Laparoscopic), 6 (Conventional)					
Heterogeneity: Tau^2=0; Chi^2=0.58, df=3(P=0.9); I^2=0%					
Test for overall effect: Z=1.12(P=0.26)					



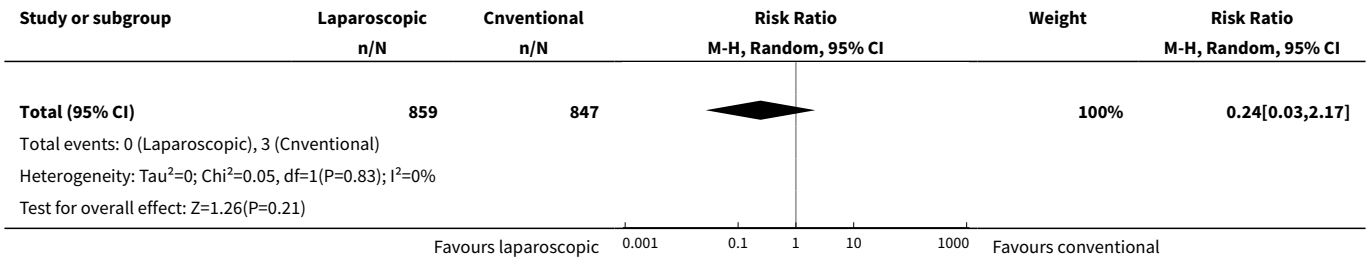
Favours laparoscopic — Favours conventional

Analysis 9.7. Comparison 9 Local (Surgical) Morbidity, Outcome 7 Fascial disrupture.

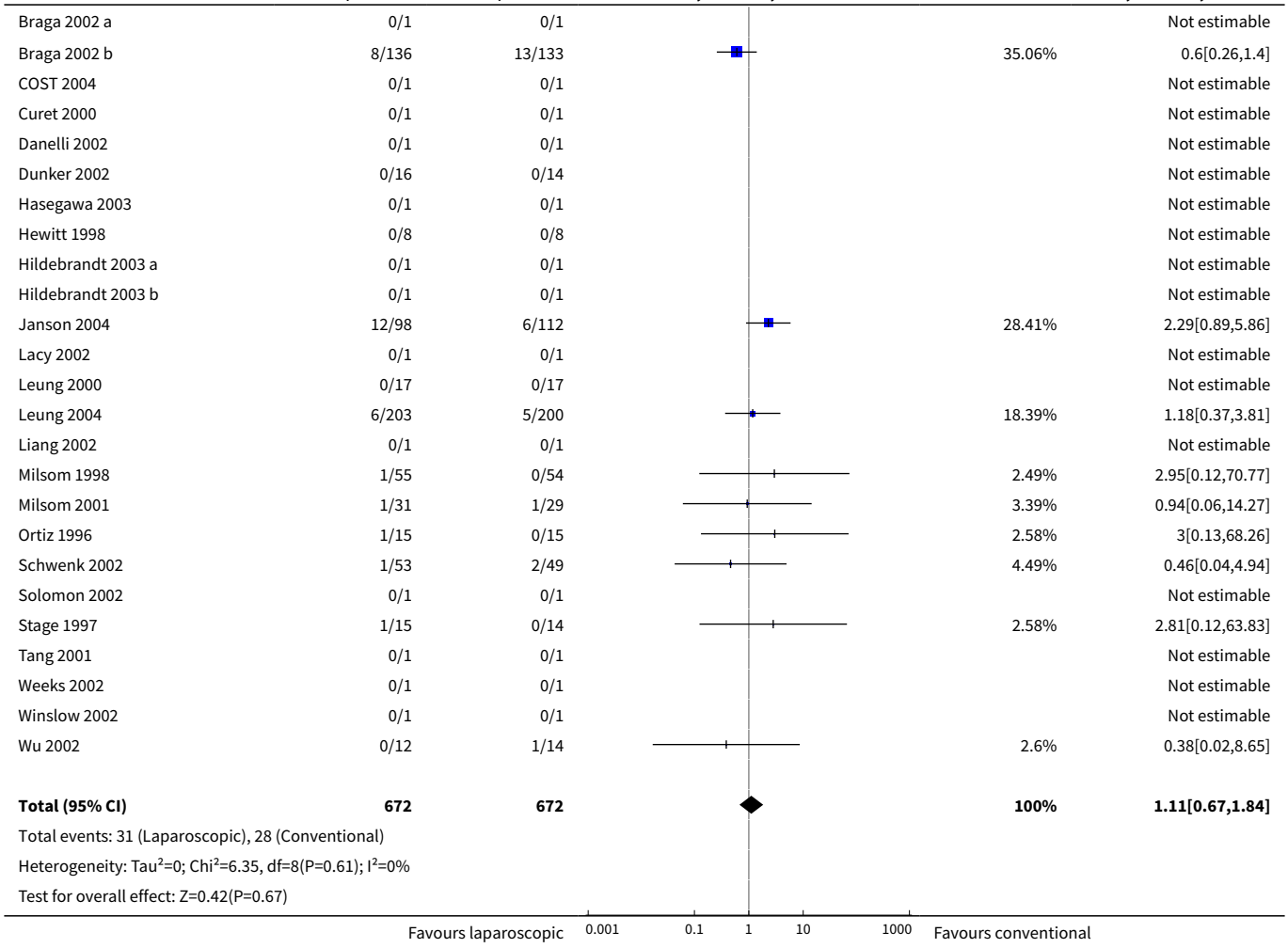
Study or subgroup	Laparoscopic n/N	Cnventional n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
Braga 2002 a	0/1	0/1			Not estimable
Braga 2002 b	0/136	0/133			Not estimable
COST 2004	0/1	0/1			Not estimable
Curet 2000	0/18	0/18			Not estimable
Danelli 2002	0/1	0/1			Not estimable
Dunker 2002	0/16	0/14			Not estimable
Hasegawa 2003	0/24	0/26			Not estimable
Hewitt 1998	0/8	0/8			Not estimable
Hildebrandt 2003 a	0/1	0/1			Not estimable
Hildebrandt 2003 b	0/1	0/1			Not estimable
Janson 2004	0/1	0/1			Not estimable
Lacy 2002	0/111	2/108		52.21%	0.19[0.01,4.01]
Leung 2000	0/17	0/17			Not estimable
Leung 2004	0/203	0/200			Not estimable
Liang 2002	0/18	0/21			Not estimable
Milsom 1998	0/55	0/54			Not estimable
Milsom 2001	0/31	1/29		47.79%	0.31[0.01,7.38]
Ortiz 1996	0/15	0/15			Not estimable
Schwenk 2002	0/53	0/49			Not estimable
Solomon 2002	0/1	0/1			Not estimable
Stage 1997	0/15	0/14			Not estimable
Tang 2001	0/118	0/118			Not estimable
Weeks 2002	0/1	0/1			Not estimable
Winslow 2002	0/1	0/1			Not estimable
Wu 2002	0/12	0/14			Not estimable



Favours laparoscopic — Favours conventional



Analysis 9.8. Comparison 9 Local (Surgical) Morbidity, Outcome 8 Reoperation for Complication.

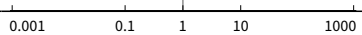


Comparison 10. General Morbidity

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 General Morbidity (Total)	25	1787	Risk Ratio (M-H, Random, 95% CI)	0.85 [0.61, 1.18]
2 Pulmonary Morbidity	25	1787	Risk Ratio (M-H, Random, 95% CI)	0.70 [0.36, 1.34]
3 Cardiac Morbidity	25	1706	Risk Ratio (M-H, Random, 95% CI)	0.81 [0.38, 1.74]
4 Urinary tract Morbidity	25	1787	Risk Ratio (M-H, Random, 95% CI)	0.88 [0.42, 1.82]
5 Deep Venous Thrombosis	25	1706	Risk Ratio (M-H, Random, 95% CI)	0.76 [0.21, 2.72]
6 Pulmonary Embolism	25	1706	Risk Ratio (M-H, Random, 95% CI)	2.95 [0.12, 70.77]

Analysis 10.1. Comparison 10 General Morbidity, Outcome 1 General Morbidity (Total).

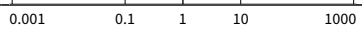
Study or subgroup	Laparoscopic n/N	Conventional n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
Braga 2002 a	0/1	0/1			Not estimable
Braga 2002 b	12/136	16/133		21.79%	0.73[0.36,1.49]
COST 2004	0/1	0/1			Not estimable
Curet 2000	0/18	3/18		1.31%	0.14[0.01,2.58]
Danelli 2002	0/1	0/1			Not estimable
Dunker 2002	0/16	0/14			Not estimable
Hasegawa 2003	0/24	0/26			Not estimable
Hewitt 1998	0/8	0/8			Not estimable
Hildebrandt 2003 a	0/1	0/1			Not estimable
Hildebrandt 2003 b	0/1	0/1			Not estimable
Janson 2004	0/1	0/1			Not estimable
Lacy 2002	3/111	3/108		4.4%	0.97[0.2,4.72]
Leung 2000	2/17	4/17		4.51%	0.5[0.11,2.38]
Leung 2004	30/203	27/200		47.2%	1.09[0.68,1.77]
Liang 2002	1/18	3/21		2.32%	0.39[0.04,3.42]
Milsom 1998	4/55	3/54		5.22%	1.31[0.31,5.58]
Milsom 2001	0/31	1/29		1.1%	0.31[0.01,7.38]
Ortiz 1996	0/15	0/15			Not estimable
Schwenk 2002	3/53	6/49		6.19%	0.46[0.12,1.75]
Solomon 2002	0/1	0/1			Not estimable
Stage 1997	1/15	0/14		1.12%	2.81[0.12,63.83]
Tang 2001	0/118	2/118		1.2%	0.2[0.01,4.12]
Weeks 2002	0/1	0/1			Not estimable
Winslow 2002	2/37	3/46		3.64%	0.83[0.15,4.7]
Wu 2002	0/12	0/14			Not estimable
Total (95% CI)	**895**	**892**		**100%**	**0.85[0.61,1.18]**
Total events: 58 (Laparoscopic), 71 (Conventional)					
Heterogeneity: Tau^2=0; Chi^2=6.68, df=11(P=0.82); I^2=0%					
Test for overall effect: Z=0.98(P=0.33)					



Favours laparoscopic — Favours conventional

Analysis 10.2. Comparison 10 General Morbidity, Outcome 2 Pulmonary Morbidity.

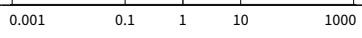
Study or subgroup	Laparoscopic n/N	Conventional n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
Braga 2002 a	0/1	0/1			Not estimable
Braga 2002 b	3/136	5/133		21.58%	0.59[0.14,2.41]
COST 2004	0/1	0/1			Not estimable
Curet 2000	0/18	1/18		4.37%	0.33[0.01,7.68]
Danelli 2002	0/1	0/1			Not estimable
Dunker 2002	0/16	0/14			Not estimable
Hasegawa 2003	0/24	0/26			Not estimable
Hewitt 1998	0/8	0/8			Not estimable
Hildebrandt 2003 a	0/1	0/1			Not estimable
Hildebrandt 2003 b	0/1	0/1			Not estimable
Janson 2004	0/1	0/1			Not estimable
Lacy 2002	0/111	0/108			Not estimable
Leung 2000	0/17	0/17			Not estimable
Leung 2004	6/203	5/200		31.36%	1.18[0.37,3.81]
Liang 2002	0/18	1/21		4.36%	0.39[0.02,8.93]
Milsom 1998	1/55	1/54		5.7%	0.98[0.06,15.3]
Milsom 2001	0/31	1/29		4.3%	0.31[0.01,7.38]
Ortiz 1996	0/15	0/15			Not estimable
Schwenk 2002	0/53	3/49		4.98%	0.13[0.01,2.5]
Solomon 2002	0/1	0/1			Not estimable
Stage 1997	1/15	0/14		4.41%	2.81[0.12,63.83]
Tang 2001	0/118	2/118		4.69%	0.2[0.01,4.12]
Weeks 2002	0/1	0/1			Not estimable
Winslow 2002	2/37	3/46		14.26%	0.83[0.15,4.7]
Wu 2002	0/12	0/14			Not estimable
Total (95% CI)	**895**	**892**		**100%**	**0.7[0.36,1.34]**
Total events: 13 (Laparoscopic), 22 (Conventional)					
Heterogeneity: Tau^2=0; Chi^2=4.23, df=9(P=0.9); I^2=0%					
Test for overall effect: Z=1.08(P=0.28)					



Favours laparoscopic — Favours conventional

Analysis 10.3. Comparison 10 General Morbidity, Outcome 3 Cardiac Morbidity.

Study or subgroup	Laparoscopic n/N	Conventional n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
Braga 2002 a	0/1	0/1			Not estimable
Braga 2002 b	5/136	7/133		45.87%	0.7[0.23,2.15]
COST 2004	0/1	0/1			Not estimable
Curet 2000	0/18	1/18		5.87%	0.33[0.01,7.68]
Danelli 2002	0/1	0/1			Not estimable
Dunker 2002	0/16	0/14			Not estimable
Hasegawa 2003	0/24	0/26			Not estimable
Hewitt 1998	0/8	0/8			Not estimable
Hildebrandt 2003 a	0/1	0/1			Not estimable
Hildebrandt 2003 b	0/1	0/1			Not estimable



Favours laparoscopic — Favours conventional

Study or subgroup	Laparoscopic n/N	Conventional n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
Janson 2004	0/1	0/1			Not estimable
Lacy 2002	0/111	0/108			Not estimable
Leung 2000	0/17	1/17		5.89%	0.33[0.01,7.65]
Leung 2004	4/203	3/200		26.24%	1.31[0.3,5.79]
Liang 2002	0/18	1/21		5.86%	0.39[0.02,8.93]
Milsom 1998	2/55	1/54		10.28%	1.96[0.18,21.02]
Milsom 2001	0/31	0/29			Not estimable
Ortiz 1996	0/15	0/15			Not estimable
Schwenk 2002	0/53	0/49			Not estimable
Solomon 2002	0/1	0/1			Not estimable
Stage 1997	0/15	0/14			Not estimable
Tang 2001	0/118	0/118			Not estimable
Weeks 2002	0/1	0/1			Not estimable
Winslow 2002	0/1	0/1			Not estimable
Wu 2002	0/12	0/14			Not estimable
Total (95% CI)	**859**	**847**		**100%**	**0.81[0.38,1.74]**
Total events: 11 (Laparoscopic), 14 (Conventional)					
Heterogeneity: Tau^2=0; Chi^2=1.84, df=5(P=0.87); I^2=0%					
Test for overall effect: Z=0.54(P=0.59)					

Analysis 10.4. Comparison 10 General Morbidity, Outcome 4 Urinary tract Morbidity.

Study or subgroup	Laparoscopic n/N	Conventional n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
Braga 2002 a	0/1	0/1			Not estimable
Braga 2002 b	2/136	4/133		18.78%	0.49[0.09,2.62]
COST 2004	0/1	0/1			Not estimable
Curet 2000	0/18	0/18			Not estimable
Danelli 2002	0/1	0/1			Not estimable
Dunker 2002	0/16	0/14			Not estimable
Hasegawa 2003	0/24	0/26			Not estimable
Hewitt 1998	0/8	0/8			Not estimable
Hildebrandt 2003 a	0/1	0/1			Not estimable
Hildebrandt 2003 b	0/1	0/1			Not estimable
Janson 2004	0/1	0/1			Not estimable
Lacy 2002	1/111	0/108		5.21%	2.92[0.12,70.89]
Leung 2000	0/17	2/17		6.03%	0.2[0.01,3.88]
Leung 2004	8/203	7/200		53.54%	1.13[0.42,3.05]
Liang 2002	0/18	1/21		5.38%	0.39[0.02,8.93]
Milsom 1998	0/55	0/54			Not estimable
Milsom 2001	0/31	0/29			Not estimable
Ortiz 1996	0/15	0/15			Not estimable
Schwenk 2002	2/53	0/49		5.85%	4.63[0.23,94.1]
Solomon 2002	0/1	0/1			Not estimable
Stage 1997	0/15	0/14			Not estimable
Tang 2001	0/118	1/118		5.21%	0.33[0.01,8.1]
Weeks 2002	0/1	0/1			Not estimable

Study or subgroup	Laparoscopic n/N	Conventional n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
Winslow 2002	0/37	0/46			Not estimable
Wu 2002	0/12	0/14			Not estimable
Total (95% CI)	**895**	**892**		**100%**	**0.88[0.42,1.82]**
Total events: 13 (Laparoscopic), 15 (Conventional)					
Heterogeneity: Tau^2=0; Chi^2=3.99, df=6(P=0.68); I^2=0%					
Test for overall effect: Z=0.35(P=0.72)					

Favours laparoscopic — Favours conventional

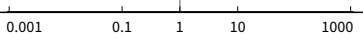
Analysis 10.5. Comparison 10 General Morbidity, Outcome 5 Deep Venous Thrombosis.

Study or subgroup	Laparoscopic n/N	Conventional n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
Braga 2002 a	0/1	0/1			Not estimable
Braga 2002 b	1/136	0/133		15.92%	2.93[0.12,71.39]
COST 2004	0/1	0/1			Not estimable
Curet 2000	0/18	1/18		16.48%	0.33[0.01,7.68]
Danelli 2002	0/1	0/1			Not estimable
Dunker 2002	0/16	0/14			Not estimable
Hasegawa 2003	0/24	0/26			Not estimable
Hewitt 1998	0/8	0/8			Not estimable
Hildebrandt 2003 a	0/1	0/1			Not estimable
Hildebrandt 2003 b	0/1	0/1			Not estimable
Janson 2004	0/1	0/1			Not estimable
Lacy 2002	0/111	0/108			Not estimable
Leung 2000	0/17	1/17		16.52%	0.33[0.01,7.65]
Leung 2004	0/203	4/200		19.08%	0.11[0.01,2.02]
Liang 2002	0/18	0/21			Not estimable
Milsom 1998	0/55	0/54			Not estimable
Milsom 2001	0/31	0/29			Not estimable
Ortiz 1996	0/15	0/15			Not estimable
Schwenk 2002	1/53	0/49		16.06%	2.78[0.12,66.62]
Solomon 2002	0/1	0/1			Not estimable
Stage 1997	0/15	0/14			Not estimable
Tang 2001	1/118	0/118		15.93%	3[0.12,72.9]
Weeks 2002	0/1	0/1			Not estimable
Winslow 2002	0/1	0/1			Not estimable
Wu 2002	0/12	0/14			Not estimable
Total (95% CI)	**859**	**847**		**100%**	**0.76[0.21,2.72]**
Total events: 3 (Laparoscopic), 6 (Conventional)					
Heterogeneity: Tau^2=0; Chi^2=4.32, df=5(P=0.5); I^2=0%					
Test for overall effect: Z=0.42(P=0.67)					

Favours laparoscopic — Favours conventional

Analysis 10.6. Comparison 10 General Morbidity, Outcome 6 Pulmonary Embolism.

Study or subgroup	Laparoscopic n/N	Conventional n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
Braga 2002 a	0/1	0/1			Not estimable
Braga 2002 b	0/136	0/133			Not estimable
COST 2004	0/1	0/1			Not estimable
Curet 2000	0/18	0/18			Not estimable
Danelli 2002	0/1	0/1			Not estimable
Dunker 2002	0/16	0/14			Not estimable
Hasegawa 2003	0/24	0/26			Not estimable
Hewitt 1998	0/8	0/8			Not estimable
Hildebrandt 2003 a	0/1	0/1			Not estimable
Hildebrandt 2003 b	0/1	0/1			Not estimable
Janson 2004	0/1	0/1			Not estimable
Lacy 2002	0/111	0/108			Not estimable
Leung 2000	0/17	0/17			Not estimable
Leung 2004	0/203	0/200			Not estimable
Liang 2002	0/18	0/21			Not estimable
Milsom 1998	1/55	0/54		100%	2.95[0.12,70.77]
Milsom 2001	0/31	0/29			Not estimable
Ortiz 1996	0/15	0/15			Not estimable
Schwenk 2002	0/53	0/49			Not estimable
Solomon 2002	0/1	0/1			Not estimable
Stage 1997	0/15	0/14			Not estimable
Tang 2001	0/118	0/118			Not estimable
Weeks 2002	0/1	0/1			Not estimable
Winslow 2002	0/1	0/1			Not estimable
Wu 2002	0/12	0/14			Not estimable
Total (95% CI)	**859**	**847**		**100%**	**2.95[0.12,70.77]**
Total events: 1 (Laparoscopic), 0 (Conventional)					
Heterogeneity: Not applicable					
Test for overall effect: Z=0.67(P=0.51)					



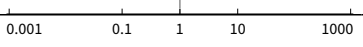
Favours laparoscopic — Favours conventional

Comparison 11. Mortality

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Mortality	25	2410	Risk Ratio (M-H, Random, 95% CI)	0.78 [0.34, 1.79]

Analysis 11.1. Comparison 11 Mortality, Outcome 1 Mortality.

Study or subgroup	Laparoscopic n/N	Conventional n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
Braga 2002 a	0/40	0/39			Not estimable
Braga 2002 b	1/136	0/133		6.68%	2.93[0.12,71.39]



Favours laparoscopic — Favours conventional

Study or subgroup	Laparoscopic n/N	Conventional n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
COST 2004	2/435	4/428		23.78%	0.49[0.09,2.67]
Curet 2000	0/18	0/18			Not estimable
Danelli 2002	0/1	0/1			Not estimable
Dunker 2002	0/16	0/14			Not estimable
Hasegawa 2003	0/24	0/26			Not estimable
Hewitt 1998	0/8	0/8			Not estimable
Hildebrandt 2003 a	0/1	0/1			Not estimable
Hildebrandt 2003 b	0/1	0/1			Not estimable
Janson 2004	0/1	0/1			Not estimable
Lacy 2002	1/111	3/108		13.48%	0.32[0.03,3.07]
Leung 2000	0/17	0/17			Not estimable
Leung 2004	5/203	4/200		40.28%	1.23[0.34,4.52]
Liang 2002	0/18	0/21			Not estimable
Milsom 1998	1/55	1/54		9.03%	0.98[0.06,15.3]
Milsom 2001	0/31	0/29			Not estimable
Ortiz 1996	0/15	0/15			Not estimable
Schwenk 2002	0/53	1/49		6.74%	0.31[0.01,7.4]
Solomon 2002	0/1	0/1			Not estimable
Stage 1997	0/15	0/14			Not estimable
Tang 2001	0/1	0/1			Not estimable
Weeks 2002	0/1	0/1			Not estimable
Winslow 2002	0/1	0/1			Not estimable
Wu 2002	0/12	0/14			Not estimable
Total (95% CI)	**1215**	**1195**		**100%**	**0.78[0.34,1.79]**
Total events: 10 (Laparoscopic), 13 (Conventional)					
Heterogeneity: $Tau^2=0$; $Chi^2=2.36$, df=5(P=0.8); $I^2=0\%$					
Test for overall effect: Z=0.58(P=0.56)					

Favours laparoscopic — Favours conventional

WHAT'S NEW

Date	Event	Description
5 August 2008	Amended	Converted to new review format.

HISTORY

Protocol first published: Issue 3, 2001
Review first published: Issue 3, 2005

Date	Event	Description
31 January 2005	New citation required and conclusions have changed	Substantive amendment

CONTRIBUTIONS OF AUTHORS

All reviewers participated in the review of the literature, data extraction, methodological scoring of the manuscripts, performance of the meta analysis and preparation of the text.

DECLARATIONS OF INTEREST

None known.

INDEX TERMS

Medical Subject Headings (MeSH)

Blood Loss, Surgical; Colectomy [*methods]; Colorectal Neoplasms [*surgery]; Laparoscopy [adverse effects] [*methods]; Randomized Controlled Trials as Topic

MeSH check words

Female; Humans; Male